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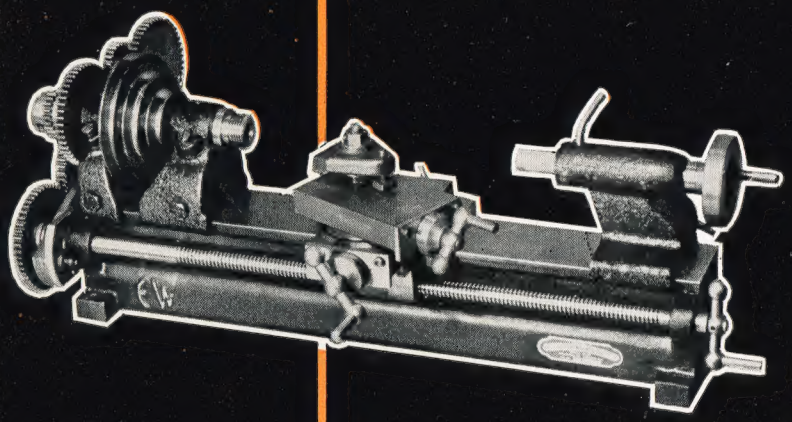

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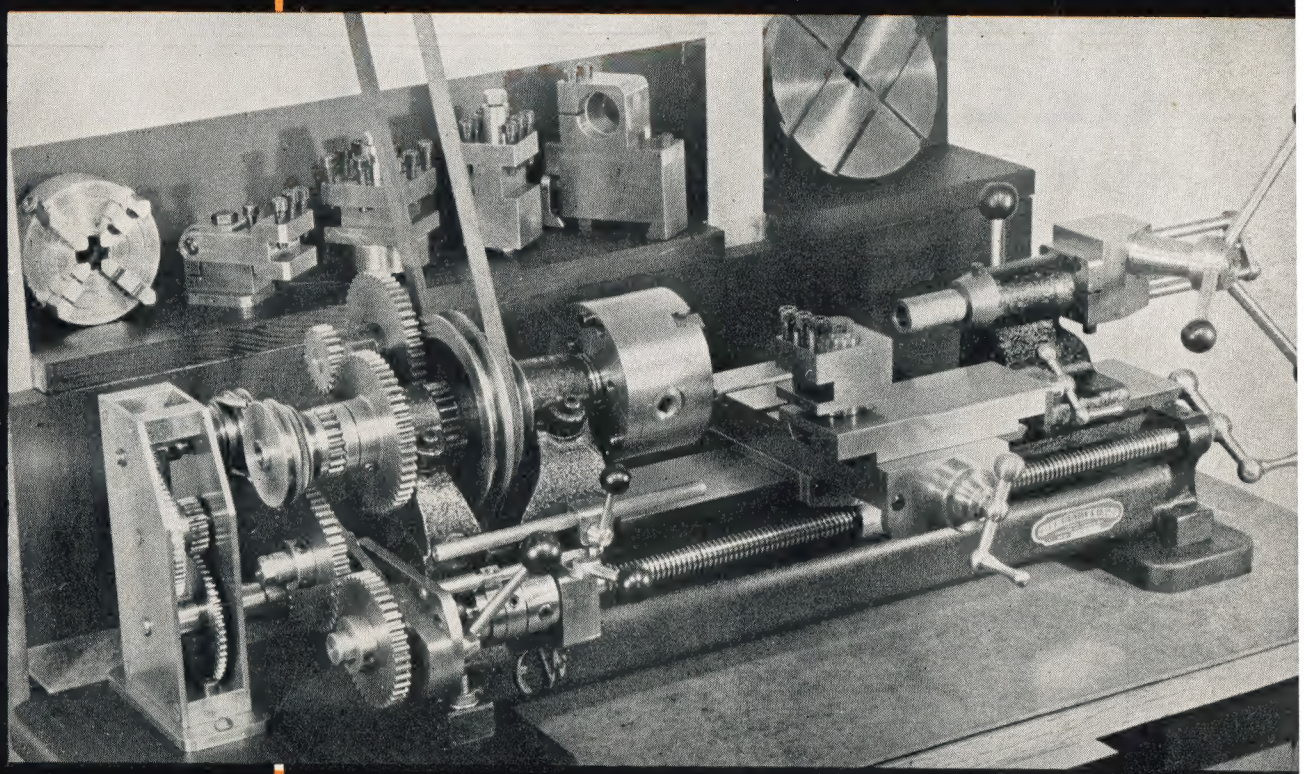

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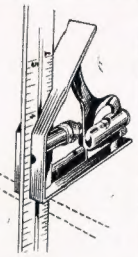

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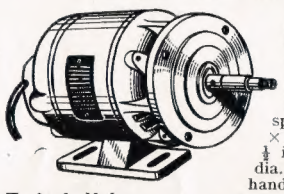

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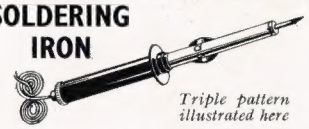

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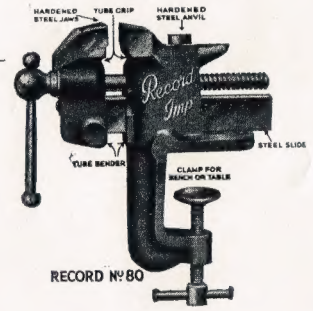

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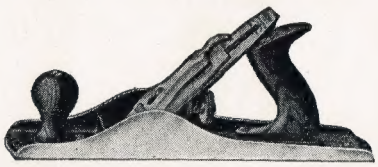

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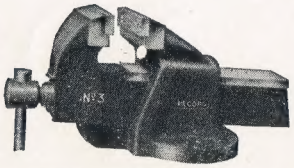

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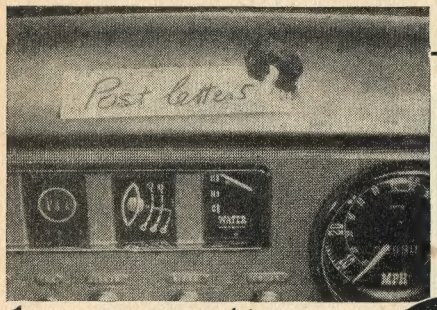

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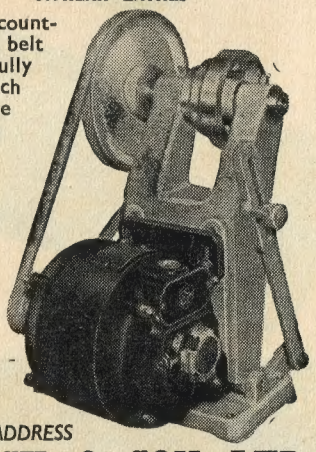

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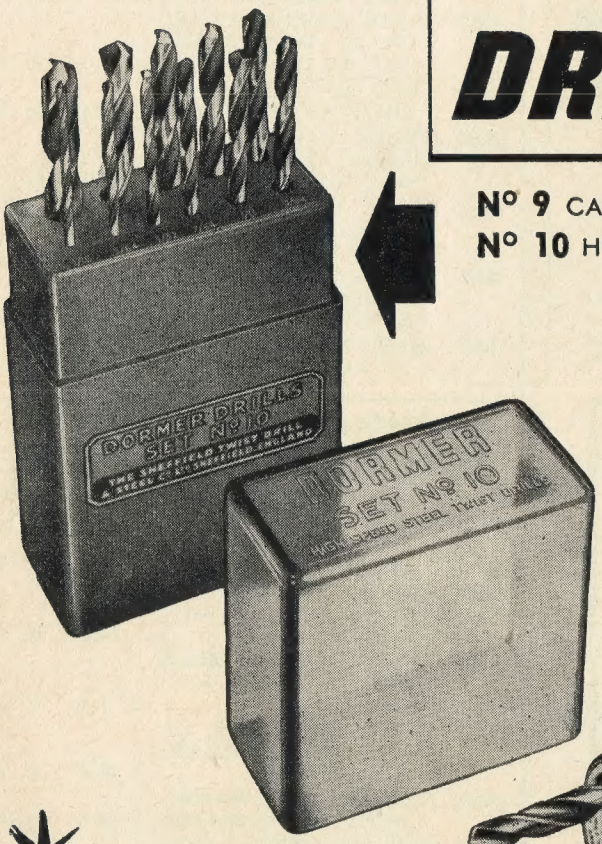

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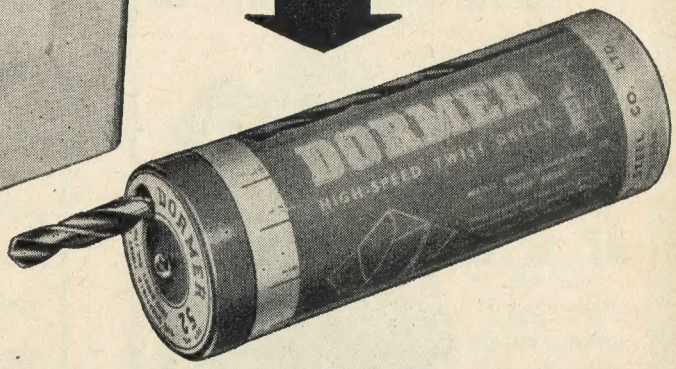

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NEXT WEEK

Serena: A model steam yacht based on diesel powered prototypes of the 1930s

Split housings: Split housings for ball races

Guinness railway: Story of the fascinating little steam line in the Dublin brewery

Rust in the workshop

The Editor is pleased to consider contributions for publication in MODEL ENGINEER. Manuscripts should be accompanied by photographs and/or drawings and should have a stamped addressed envelope for their return if unsuitable. None of the contents of MODEL ENGINEER may be reproduced without written permission. All correspondence should be addressed to the Editor, Model Engineer, 19-20 Noel Street, London, W1.

Smoke Rings

A WEEKLY COMMENTARY BY VULCAN

IN our issue for 10 November 1955, J. N. Maskelyne published a description of an old notebook that had been lent to him, dealing with GWR locomotive history of the 1850s. Just lately, he has become possessed of another book of a larger size but of a similar kind.

It is surprising how such things are occasionally found, but how rarely they come into the hands of people who really appreciate them.

This latest discovery of JNM's is a real prize which any locomotive historian would almost give his life to possess. It is bound in a leatherette cover, entitled *Mechanical Drawings*, is 10 in. × 15 in. in size and contains 58 pages of original drawings and sketches of locomotives of the old London Chatham and Dover Railway, and numerous details. They seem to be the work of Dampier Shaw, whose name appears in the book, and it is dated May 1868.

There can be no doubt that Dampier Shaw was a draughtsman at the old Longhedge Works, Battersea, London, SW, where most of the LCDR locomotives were built.

Considerable skill

His skill as a draughtsman is typical of the period, as all the drawings have been done in ink in fine-line style; all centre-lines are in red ink, and all sections have been carefully coloured in weak water-colour wash to indicate the metals of which the parts are made.

The numerous free-hand sketches are most remarkable; their execution and accuracy must be seen to be believed, and one wonders what kind of pen was used in their making. In them, as in the properly-constructed drawings, the fine-line technique and colour-wash are strictly maintained, while the lettering—sometimes literally microscopic in size—is always clearly legible.

Their is a beautifully-executed part-section drawing of a four-wheeled first-class coach, and another showing the layout of what is described as "Edwards' Communicator"—a mechanical forerunner of the modern communication cord—which enabled a passenger to sound a gong on the engine in case of emergency.

What may be the cash value of a book like this is impossible to say; but as an historical relic the book is priceless.

One of the most interesting items in it is a small loose sheet on which is a drawing, signed "Dampier" and entitled "Model Loco Cylinders." But more of this later.

Railway artists

WHY are so many railway people keen amateur artists? Allowing for the present great popularity of painting, a movement that owes a good deal to the examples of Churchill and Eisenhower, the number of artists among the staffs of British Railways still seems remarkable.

Smoke Rings . . .

I called at Liverpool Street station in London the other day to see the exhibition arranged by the Eastern Region of the BR Staff Association. My first impression was that I was in an art gallery. No fewer than 104 paintings and drawings made the gymnasium a gay oasis of colour on a rather dull afternoon.

Our amateur railway artists, I think, prefer the Western Region when they go forth with brush and easel. So many memories of Cornwall decorated the walls of this exhibition that I suggest a link with the Penwith Society of Arts in St Ives where a summer exhibition might be arranged.

Nautical flavour

Art was so much ahead of crafts at Liverpool Street that the models, by comparison, made a modest showing. I found exactly one locomotive—an uncompleted Britannia by R. W. Footman whose initiative in sending a model railway engine to a railway exhibition deserves to be honoured here. Apart from a scale flying model of the Siskin 111 1919 fighter by L. E. Cook, all the other catalogued models belonged to the sea.

The largest and most impressive ship model was of the British Railways steamer *Arnhem*, on service between Harwich and the Hook of Holland. Built at a scale of ⅜ in. to the foot, this model does credit to Parkeston BRSA Branch, and in particular to those who worked with W. W. Sallows in building it.

Last year it was entered in the Harwich Shipwrights Guy Carnival, which sounds to me like a bit of Merrie England.

Planetarium

I STOPPED in Marylebone Road the other day to watch the work in progress next door to Madame Tussaud's. Here, one a bombed site, the directors of the famous waxworks are erecting London's first planetarium

In a planetarium the images of the heavenly bodies are thrown on to the inner surface of a large dome through the use of apparatus which simulates their motions without the apparent slowness which attends their study in the actual sky. It was Dr W. Bauersfeld of the Carl Zeiss company who devised this convenient firmament in 1919; and it is in the Zeiss works at Oberkochen that a £50,000 projector is being completed.

The Zeiss projectors at Munich and The Hague are of the fixed-latitude type with a globe of 50 cm. diameter, containing 31 optical projectors and a central 200 w. lamp for reproducing stars of the first to the sixth magnitude. When the electric motor is operated, images of the stars travel over the dome and reproduce in a few minutes the appearances brought about by the earth's diurnal rotation. In seven compartments underneath the globe are projectors for forming images of the sun, the moon, and the five best-known planets.

The globe rotates on a polar axis fixed for one particular latitude (Munich-about 42 deg.) but in 1926 Dr Walter Villiger of Zeiss invented a more versatile composite projector representing the night sky for all possible geographical latitudes.

Cover picture

Our cover shows the improvement introduced to the EW lathe by Martin Cleeve. Top picture shows the lathe before modification. See story on pages 884 *to* 886

Wrongly attributed

I AM glad to put right an error which concerns an article describing the model of *Campania* which appeared in MODEL ENGINEER on 11 April 1957.

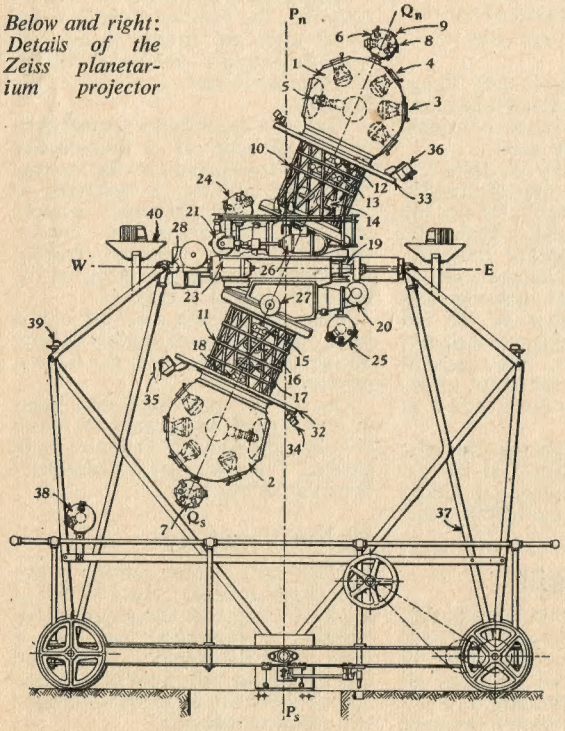
It was sent to us by Mr Arthur E. Hughes, of Braintree, Mass., and was wrongly attributed to him.

In fact, the model was built by Mr Paul Huntington and he also described the model.

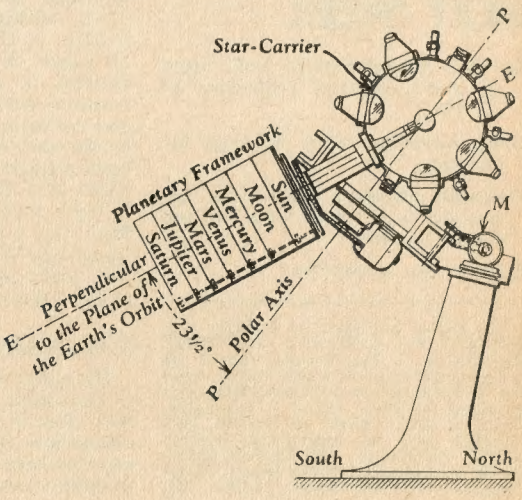
Mr Hughes met Mr Huntington at a meeting of the Steam Boat Historical Society of Massachusetts Institute of Technology and was very impressed with his five models. *Campania* is nearly five feet long and steams beautifully.

So let me give honour where honour is due . . . to Mr Paul Huntington.

Below and right: Details of the Zeiss planetarium projector



The two illustrations are reproduced by courtesy of "Engineering"



SIMPLIFIED RADIO CONTROL

R. H. CURWEN describes a method of adding extra controls with the minimum of equipment

WHEN thinking out ways and means of introducing additional controls to simple r.c. steering systems, it is all too easy to add relays and escapements with the necessary batteries to operate them, until the layout approaches the complexity of a telephone exchange. While this type of gear is interesting to adjust and to operate, it is often unnecessarily elaborate for the functions which it has to perform.

For the normal use of a model power boat, apart from demonstration work, one or two extra controls will meet all needs. Let us see, therefore, what can be done with simple equipment.

Assuming that you have a transmitter and receiver of the simple carrier operated type, all that will be required is a pulser for the mark/space modulation of the transmitter, and either one or two delayed relays at the receiving end.

RELAY MODIFICATIONS

As the current drawn by the steering motor is to be used to energise the slugged relays, no additional batteries are required for the extra controls; and in order to avoid undue voltage drop, the resistance of the relay coils must be of a low order—about 5 ohms is a satisfactory figure. The second requirement of the relay is a delayed release of about $\frac{1}{2}$ sec.

To obtain a delay of this order with a small 5 ohm relay would require a large capacitor of over 1,000 mfd connected in parallel with the coil, and therefore the older method of "slugging," by means of a copper band fitted round the core of the relay, is employed.

Suitable GPO relays (Fig. 1) fitted with copper slugs *S* are obtainable from the surplus supplies stores, and they can be fitted quite easily with the necessary low resistance coils *C*; but the slugs can be turned from copper or aluminium to fit the normal relay, which may be more readily available.

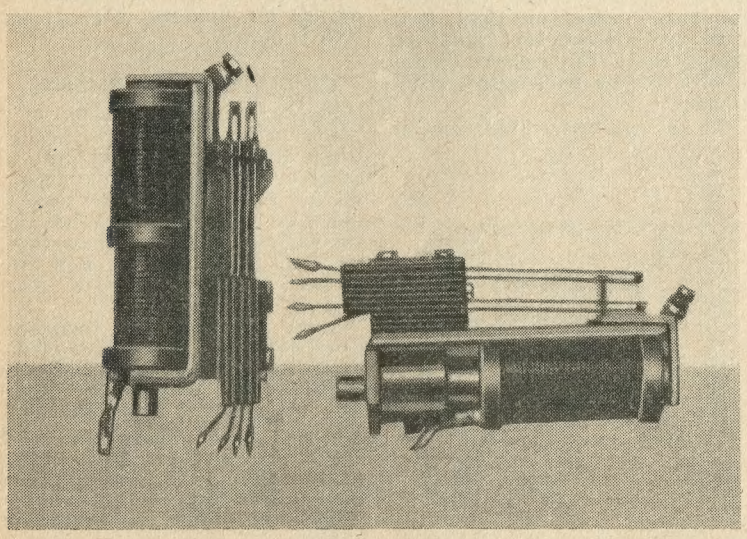
These relays appear to be made in two sizes, and that illustrated is the smaller of the two, the type 600, I believe. Both the 600 and the heavier type 3000 are produced in two forms; one with the copper slug at the armature *A* end of the core, and the other with the slug at the heel end.

In the former case the relay will be slower to operate than to release, and in the latter, as required for this system, fast to operate and slow to release. But as the slug is best removed in order to fit the new coil, either type can be adapted. A new coil should be made, having about 700 turns of 28 s.w.g. enamelled wire, which when wound on in layers will just fill a former of the dimensions shown in Fig. 2. It has small holes at *a* and *b* for the start and finish of the windings.

Ebonite or plastic material for the former gives a professional finish to the job, which can be further improved by binding with cellulose or empire tape after winding. A pair of relays so treated is illustrated in the photograph. It is possible to wind the coil by hand, or with the aid of a wheel brace clamped in the vice; but to use a lathe for this purpose saves a lot of time.

My own method is to slip the wooden reel on to a spindle fixed to the wall above the lathe, and to guide and tension the wire through the fingers on to the former which is mounted on a stub in the chuck. If the topslide is brought up to support the wrist, the wire can be put on in the smooth layers which are essential to enable the full number of turns to be wound in the available space.

To count the turns, the ex-Government rev counter (shown for identifi-



A pair of slugged relays after fitting with new coils

cation purposes in Fig. 3) is simply plugged into the back end of the hollow lathe mandrel, for which purpose its spindle—after the removal of the short flexible drive cable—has been fitted with a rubber sleeve; and due to the right-angle bevel-gear drive, the instrument hangs from its spindle and requires no further fixing.

With its zero reset knob, I regard this as one of my most useful finds, and I believe this type of counter is still obtainable at a price of 7s. 6d. from the Service Trading Co., of 9 Little Newport Street, London, W.C.2. No insulation is required between the core and the slug, but a touch of Chatterton's compound, or glue, to the core before re-assembly will keep everything firm.

The contact arrangements fitted to GPO relays are very varied, but it is always possible to re-arrange these in order to provide the necessary switching—even if one has to use two pairs of contacts, as shown, connected in series. Any spare contacts should be removed for future use as limit switches.

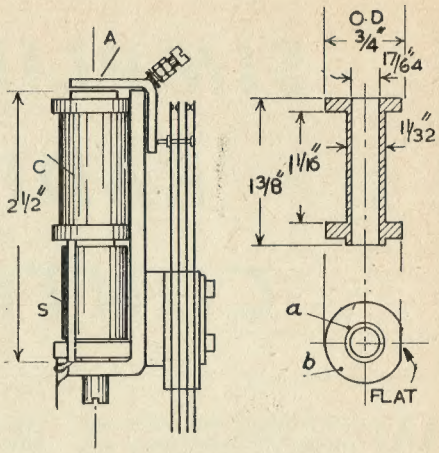
As the armature operates against the spring pressure of the contact leaves, in setting these the tension must be kept quite light in order to avoid an undue reduction of the release delay period; and it is advisable to bend the armature slightly to reduce the gap between the pole faces to about 10 thou. Gaps of about 5 thou between the contact points are satisfactory.

It will be noticed that the armature carries in the centre of its pole face, either a brass pip or a screw with locknut, the purpose of which is to prevent the armature from sticking to the core magnetically. The projection of this pip should be reduced to about 2 thou.

SYSTEM OF CONTROL

You now have a relay which will hold in so long as it is energised by short pulses of direct current at a frequency of not less than about 200 per minute.

It is usual, when steering by the mark/space method, to transmit either a long mark or a long space in order to move the rudder quickly either to port or to starboard; but in the system here described the variation of the mark/space ratio used for steering control is limited in range between 4/1 and 1/4, which has the effect of reducing the rate of steering by 40 per cent.



Figs 1 and 2: The slugged relay and coil former

This should be borne in mind when designing the steering gear; not forgetting that the faster the boat, the faster must be the rate of steering, and the higher must be the power to produce the necessary torque at the rudder.

Any type of motor-driven steering unit can be used; but for this system limit switches can cause trouble if connected in the normal way, and are best dispensed with in favour of a slipping clutch, which in its simplest form consists of a light spring washer inserted at any convenient point in the drive. Sufficient friction is applied to drive the rudder, without stalling the motor when full helm is reached.

Most miniature 4 v. motors draw a high current when stalled; but if the 24 v. Government surplus type, such as the Delco, is fitted (and these give ample power on 12 v.), it is hardly worth the trouble of fitting the slipping clutch, as the stalled current of these motors only reaches about 0.2 amps.

On my own gear, which consists of the screw and nut type (6 BA) driven direct by a Delco motor, I have found that short lengths of rubber tube slipped over each end of the screw effectively prevent the jamming of the nut on full helm. There is one effect, inherent in the system, which is present to a varying degree according to the ratio of the reduction gear fitted to the steering.

When either a mark or a space is received, the rudder will move a few degrees during the delay period of the slugged relay. A simple way to neutralise this effect is to transmit a short mark before each space, or vice versa, which is done by depressing the push buttons or the key in this order.

This operation becomes quite automatic after a little practice; but if preferred, the spare contacts on the telephone key can be arranged to provide the necessary blips as the lever is moved.

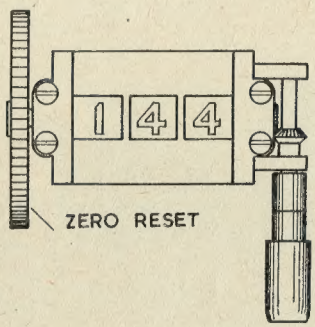


Fig. 3: Revolution counter for use in the coil winding

CIRCUIT ARRANGEMENTS

Fig 4 shows the connections of a normal mark/space steering system to which additional controls can be added by the insertion of the slugged relays. In all diagrams the steering motor is marked *SM*, and *X* indicates the positions of the on-off switches; the relay contacts are in each case lettered to correspond to their respective operating coils.

Spark suppressors are connected, as shown, across the contacts of the anode relay *A* and consist of condensers of 0.1 mfd capacity in series with a resistor of about 50 ohms. The contacts of the slugged relays should be protected in a similar manner, although the necessary components have been omitted from the circuits which follow, for the sake of clarity.

The simplest arrangement for the

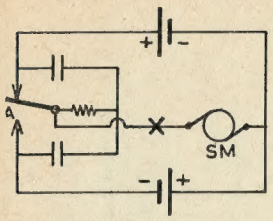


Fig. 4: The connections of a normal mark/space steering system

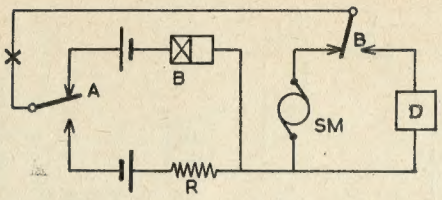


Fig. 5: A simple arrangement for operating one extra control D

operation of one extra control *D* is depicted in Fig. 5, which employs one slugged relay *B*.

If a 4 v. steering motor is fitted, it is advisable to insert a 5 ohm resistor *R* to balance the circuit; but this can be omitted when using a motor of higher voltage rating.

In this diagram, and those which follow, the circuits are shown in the mark/space condition with the steering in operation; and assuming that contacts *A* are in the mark position, it can be seen that the receipt of a continuous space will de-energise *B* and connect *D*.

Fig. 6 shows how the addition of a second pair of contacts to relay *B* allows the use of a motor-driven stepping type of servo—similar to that which I have used for the throttle control on *Vanessa*, recently described in MODEL ENGINEER.

The addition of the second slugged relay, *C* (Fig. 7) makes it possible to have two-way progressive control of both steering and throttle *TM*. In this case a second screw-and-nut type of servo can be employed to open or close the throttle to a degree which is proportional to the length of the mark or space transmitted, and limit switches *LS* can be fitted if required.

This arrangement has also proved most useful for sail control on a model yacht. The final circuit (Fig. 8) shows the addition of a third control *E*, and other arrangements will no doubt occur to the experimenter.

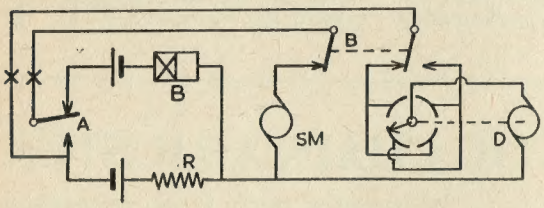


Fig. 6: A second pair of contacts to relay B *permits the use of a motor-driven stepping servo*

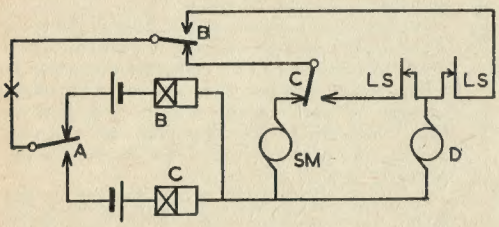


Fig. 7: Adding the second slugged relay C *makes two-way progressive control of steering and throttle possible*

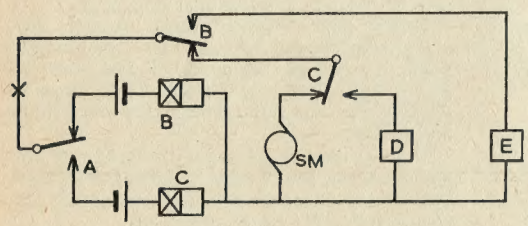


Fig. 8: The connections for the addition of a third control E

PULSER UNIT

To operate this system, you will require a unit which will switch the transmitter on and off (mark and space) automatically at a rate of not less than four times per second; and it must also be capable of providing the following mark/space ratios.

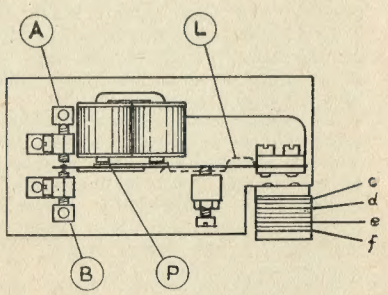
For port helm, 20/80, for rudder stationary, 50/50, and for starboard helm, 80/20. And to operate the additional controls will require either a key switch or two push switches.

The motor-driven pulse modulator, as described for the control of *Vanessa*, is suitable for this system when fitted with limit stops to reduce the swing of the control lever: but for those who may prefer electronics to mechanics, a delayed relay pulser is probably the simpler to construct. As its name suggests, this consists of a suitable relay, the time of operation and release of which can be delayed by resistors and capacitors.

Almost any relay will act as a vibrator; but to enable a low mark/space ratio to be obtained, a coil of high resistance is necessary—the higher the better; and I have successfully used relays from a large 12,000 ohm type down to a Siemens high-speed relay of 3,400 ohms. As the latter is readily available, details will be given of the correct adjustment of this relay which is shown in Fig. 9.

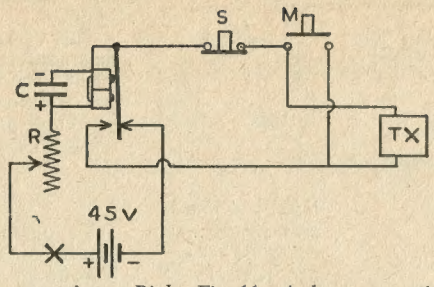
As purchased, the Siemens will require no modification other than an increase in the spring tension of the armature, which can best be obtained by removing the leaf, shown by the broken line *L*, in order to allow the adjusting screw to operate directly on the armature spring.

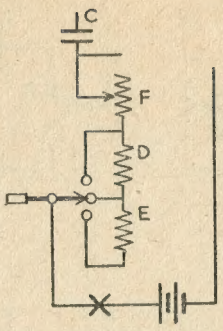
The forward contact screw *A* must now be adjusted so that the armature, when pulled in, is about 2 thou clear



Right, Fig. 9: A Siemens relay

SIMPLIFIED RADIO CONTROL . . .





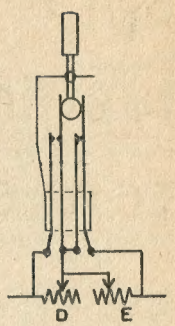


Fig. 10: Steering control connections. Right, Fig. 11: A three-way switch gives more positive control. Extreme right, Fig. 12: Connecting a telephone key for use as a three-way switch

of the magnet pole face at *P*, and the back contact *B* brought up to allow a working gap of from 2 to 3 thou. The two coils (1,700 ohms each) must be wired in series and in correct polarity by connecting together the soldering tags *c* and *e*.

For the steering control, use a variable resistance *R* of about 25,000 ohms, which should be fitted with a control lever, or a knob with pointer, so that its range can be limited by stops fixed to the lid of the control box. So that this control will normally rest in the 50/50 mark/space position, it is as well to spring load the lever in the central position, or to fix a suitable projection which can be felt by the fingers. The connections for this arrangement are shown in Fig. 10.

For more positive control, however, a three-way switch can be fitted as in Fig. 11; and though this can be made up quite simply, a telephone key will do the job well if four of its contacts are connected as in Fig. 12.

Suitable values of resistors *D* and *E*, for use with the Siemens relay, are 4,000 ohms each, with the potentiometer *F* set to about 2,000 ohms; but for ease of adjustment, and to suit other sensitive relays which may be to hand, it is a good plan to fit potentiometers, which may be of any value between 5 and 25 k ohms, in lieu of *D* and *E*, as shown in Fig. 12.

The 50 mfd condenser *C* connected across the relay coil should be of not less than 50 v. rating, and must be connected for correct polarity as shown. But when using a relay of over 5 k ohms coil resistance, it will be necessary to halve the capacity of *C* in order to keep the pulse rate above 250 per minute.

To operate the additional controls, push switches *M* (push to make) and *S* (push to break) are shown in the circuit diagram, but they can conveniently be replaced by a single telephone key with the contacts arranged in the same manner as already shown in Fig. 12.

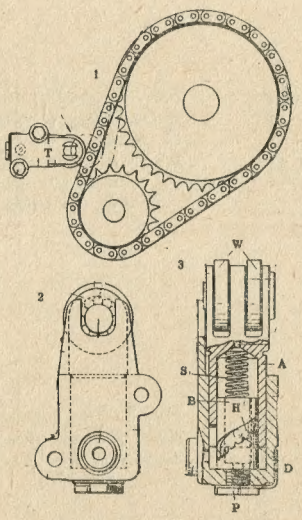
A suitable battery to power the unit is the 45 v. Ever-Ready type B106, or B109, which will enable all gear to be housed in a small box dimensioned approximately 7 in. × 4 in. × 2 in., and a switch *X* must, of course, be inserted.

The layout of the components is not shown, as this can be arranged to suit any case that may be to hand; and a plastic sandwich box, after enamelling, serves this purpose quite well.

On connecting up, it will be found that the pulse rate varies with the mark/space ratio from approximately 300 up to 600 pulses per minute; and while this does not affect the steering performance in any way, the purist can, if he desires, keep the pulse rate constant by using the spare contacts on the steering key to switch additional capacitors in and out of circuit.

The use of a pulser of this type is not confined to the above method of control, as it is readily adaptable for the pulse rate system; and a wide range of pulse frequency control can be obtained by switch variation of the capacity shunting the relay coil. ▣

AUTOMATIC CHAIN ADJUSTER



Digested from British Patent 724,523 (1955) held by the Renold and Coventry Chain Co. Ltd, of Wythenshawe, Manchester

THIS device, shown in the accompanying illustration, is intended to eliminate the slack in the chain of a light reversing drive as would be used in a timing gear where the elimination of backlash is important.

Fig. 2 shows an enlarged view of the device and Fig. 3, a sectional view.

It consists of a system of two hollow plungers *A* and *B*, the former working within the latter under the influence of a compression spring *S*, which tends to move them apart. The outer plunger *A* itself moves within a cylindrical body secured to the gearbox, and carries at one end a wheel fitment *W* (or a rubber head) pressing against the chain.

A simple pawl action occurs between a pin *D* set in the wall of *A* and running in a helical slot *H* in the wall of *B*. The upper edge of this slot is smooth and the lower serrated. When, therefore, the system of plungers extends to take up chain slack the smooth edge runs to rest on the pin, rotating *B* as it does so.

When gear reversal occurs causing, say, a slight tensioning of the chain, the plunger system is slightly compressed and the pin moves down into a serration on the opposite edge of the slot and permits only very slight movement.

Thus, in neither direction of working is play permitted on the "slack" side of the chain. The device is set or released by turning the screwed plug *P* with a special key.

Split big-end connecting rods . . .

By GEOMETER

For use on multi-cylinder engines and single-cylinder types with double-web crankshafts which cannot be dismantled, it is essential for connecting rods to have split and bolted big-end bearings. From the constructional point of view, this naturally adds to the work involved, but the processes can all be carried out accurately on a lathe with normal equipment.

In detail, connecting rods may vary according to the designer's ideas or in keeping with the engine being made. For open type horizontal internal combusion engines and steam engines, connecting rods may be of steel with flat ends and split brasses bolted up with steel plates at the ends, as at *A* left. Alternatively, steel connecting rods may be bored as at *A* right—in which case they are provided with brass or bronze liners—or white metal is run direct on the steel and machined to form the actual bearings. Again, brass or steel liners may be lined with white metal for fitting to the rods. Where reduction of weight is important, as in small high-speed engines, connecting rods may be of duralumin, working direct on crankpins and gudgeon pins.

Sections of connecting rods are usually round for the type at *A* left, and rectangular or I-section for that at *A* right. Bearing liners or shells may be flanged at the ends to run in the crank cheeks, or the connecting rods themselves may thus locate and carry flush-fitting liners, as at *B* left and right, respectively. A simple means of locating shells is a pin screwed into the rod or cap fitting in a hole in one half.

In small model sizes, whatever the type of connecting rod being made, it is useful to employ rectangular material and bore the gudgeon-pin hole first—with the bar clamped flat to the faceplate. The bar can then be held in the independent chuck and the end faced, either to take the flat brasses or to the centre line for fitting the cap.

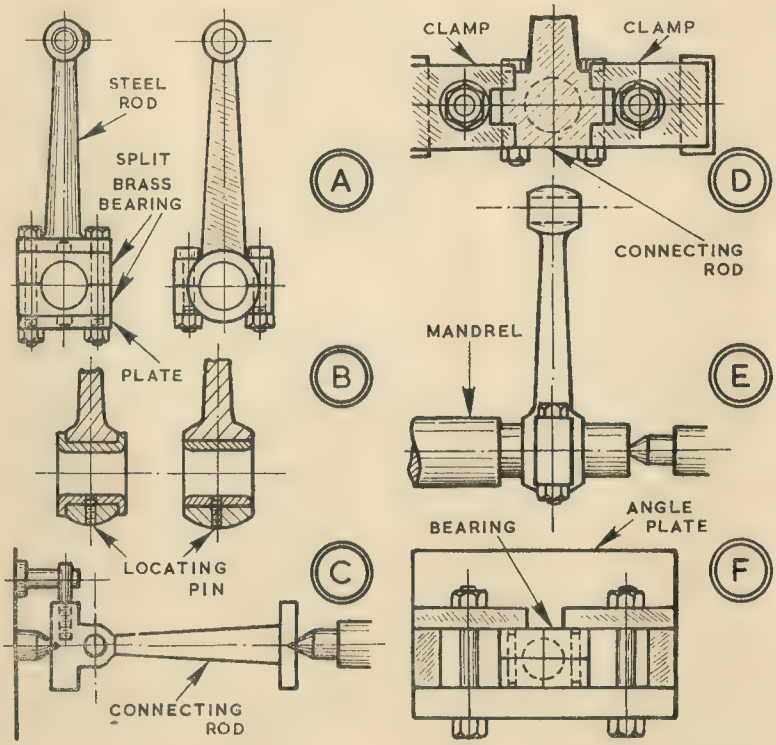
Where flat brasses will be used, the faced end of the connecting rod can be centred, then the bar reversed and the other end centred. Surplus material should be available for fitting a carrier or driving pin to effect a set-up as at *C*. The bulk of unwanted material can be sawn away, and the rod turned taper with the topslide at an angle.

The small end may be finished afterwards, sawing off the surplus material, then rounding up the boss by filing with hardened stepped plugs in the bore—the ends finally being tapered if desired by machining with the small end clamped on a threaded mandrel by a nut.

The steel plate which will hold the brasses should be drilled and clamped to the connecting rod for drilling the bolt holes—and may also be used as a template for drilling the brasses. On the other type of connecting rod, the cap material may be so employed; and where the holes are long, a set-up in the independent chuck for drilling from the tailstock is advisable.

With the cap material bolted to this type of connecting rod, the big-end can be bored by clamping to the faceplate, as at *D*, using slotted clamps for access to the joint line, which serves as one setting-up line, while a scribed line is marked on the rod for the other direction. For machining the web of the connecting rod, the set-ups described for simple connecting rods can be employed. Then the big-end may be turned at the sides with the rod clamped on a mandrel, as at *E*.

For making flat brasses, the material should be machined true if necessary by careful set-ups in the independent chuck or on the angle plate; then the halves are drilled from the steel plate and dowelled together for mounting on the angle plate, as at *F*, to machine the bore. Round brass liners may be machined similarly from two pieces of flat bar, centred and projecting from the independent chuck for machining the bore and outside at one setting. ▣



Ship modelling for beginners

In this instalment QUAYSIDER tells how to make the constructional plan and he discusses the materials which will be used in the making of the model boat

LAST MONTH I described how to make the lines plan for our model. In this instalment I propose to make the constructional plan, explaining it step by step as we proceed. It cannot be too often impressed on the beginner in ship modelling that the time spent on the design is never wasted. The one who really wastes time is he who rushes at a job without consideration and then, when halfway, finds he is hopelessly wrong and has to begin again.

Those who are not used to planning a job on a drawing board usually exaggerate the difficulty. It is largely a matter of visualising in the round what is drawn on the paper, and the ability to do so comes by practice. To cultivate the habit of sketching what one sees is a great help in this matter.

To make the constructional plan we must first trace the profile from the lines plan, indicating the positions of the perpendiculars and of the stations; see Fig. 18. The frames are located on the stations. They are made from $\frac{1}{4}$ in. plywood, preferably resin-bonded, though this is not essential, and their thickness must be shown on the drawing.

Note that the frames forward of the midship section are placed with their after faces on the station line, while those aft are placed with their forward faces on the station line. This is necessary owing to the fact that they have to be bevelled later to form a fair bed for the planks. This is especially noticeable towards the bow and stern; as the planks curve inwards toward the centre line of the ship, the frames must be bevelled to suit.

The shape of the frames is taken from the body plan, which gives the shape on the station line. As, in bevelling them, the forward frames are cut away towards their forward faces, and the after ones towards their after faces, the face not cut away must be on the station line. As the midship section is not bevelled it is immaterial whether the frame is placed forward or aft of the station line.

Before drawing the outline of the keel, a drawing showing the section at each station must be made, see Fig. 19. The outline is taken from the body plan, Fig. 17 (May 9), which shows also the width and external depth of the keel, and the level of the rail and bulwarks. A second line to show the thickness of the planking, which in our case is $\frac{1}{8}$ in., is drawn inside the outer line, and the total depth of the keel is shown.

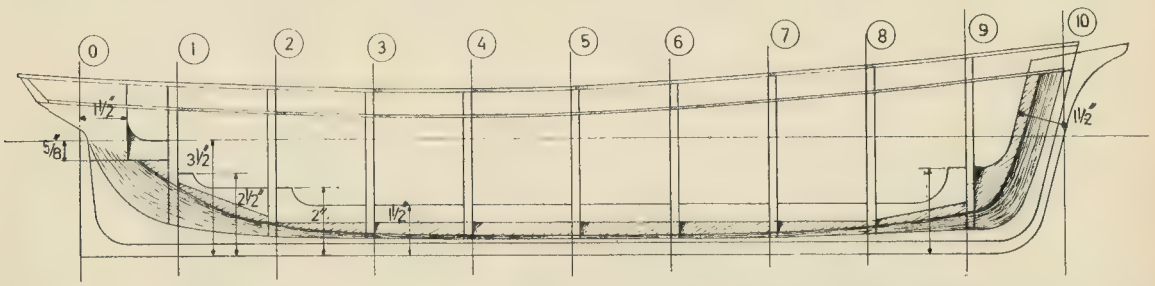


Fig. 18: *Profile constructional plan of the hull*

As we are building our framing on the principle of the egg box, we must decide on the depth necessary for the slots. I consider $\frac{1}{2}$ in. to be the minimum. With a slot $\frac{1}{2}$ in. deep in the keel, and a slot $\frac{1}{2}$ in. deep in the frames, plus $\frac{1}{8}$ in. for the thickness of the planking, and $\frac{3}{8}$ in. for the external keel, we have a total depth of keel of $1\frac{1}{2}$ in.

The deck line with its camber comes next. For a beam of 7 in. a rise amidships of $\frac{1}{8}$ in. will be about right, so we draw a line accordingly, springing from the sheer line on each side. This shows the underside of the deck, so a second line $\frac{1}{16}$ in. above it will show the deck, which should be made of $\frac{1}{16}$ in. resin-bonded three-ply.

The frames are continued up through the deck for a height of $\frac{3}{4}$ in. to receive the rail, which will be of mahogany or walnut, $\frac{1}{4}$ in. wide × $\frac{1}{8}$ in. thick. The bulwarks are made of 1 mm. or $\frac{1}{16}$ in. resin-bonded three-ply, and as the outside of the frame is flush, there will be a step of $\frac{1}{16}$ in. or so where the bulwark meets the planking.

The sheer line runs along in this step or angle, and may be a hardwood beading or, if preferred, a length of good cord. I have used heavy fishing line for this in some of my models. It can be painted or even gilded, when it gives a good finish to the model. It also has the advantage of being easily fitted. The frames should be cut out in the middle for lightness and ventilation. The drawing, Fig. 19, gives suggested dimensions for this. If the upper holes are drilled, the remainder can be cut out easily with a fret-saw.

On studying the drawings it will be seen that as the V-section becomes more pronounced towards the bow and stern the keel has to be made deeper to accommodate this. Fig. 18 will make this clear if studied in connection with Fig. 19.

Aft, at station 1, the keel is $2\frac{1}{2}$ in. deep to the top of the slot for the frame, at station 2 it is 2 in. deep, from station 3 to station 8 it is $1\frac{1}{2}$ in. deep, and forward, at station 9, it is increased again to $2\frac{1}{2}$ in. deep. The width at the stem is $1\frac{1}{2}$ in. to give a base for the bowsprit and sufficient width at the filling pieces to which the planks are secured.

To avoid any difficulty the beginner may have in working the planking under the counter, I have shown the stern made out of two blocks of wood fixed one on each side of the central web. The lower surfaces of these blocks are on waterline *D*, see Fig. 18, and their forward faces are midway

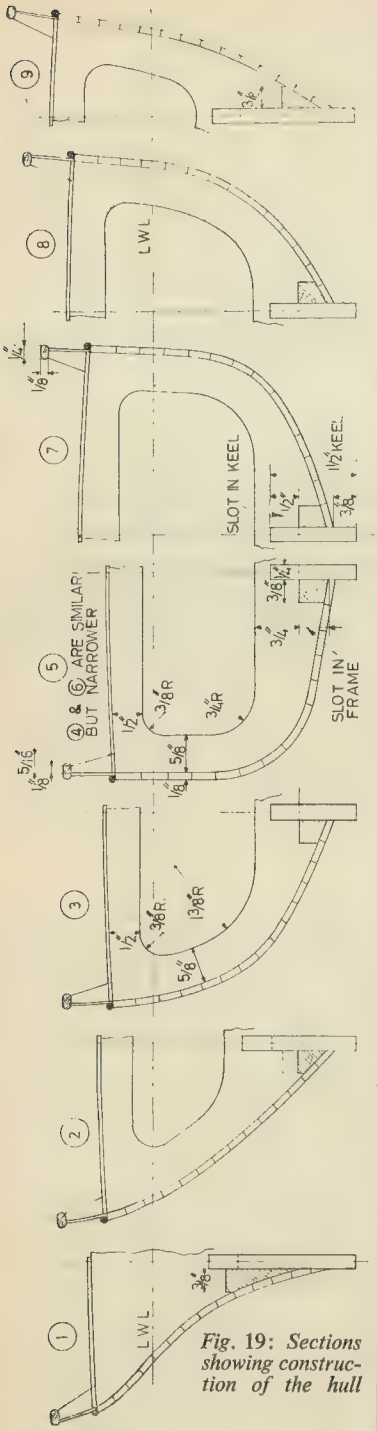


Fig. 19: Sections showing construction of the hull

between stations 0 and 1. The forward surfaces on each side are rebated to receive the ends of the planks. Fuller details of these blocks will be given in the next instalment.

Between the frames a series of filling pieces is glued on each side of the central web. These are $\frac{3}{8}$ in. thick, and whereas between stations 2 and 8 they are comparatively narrow, toward each end they are much wider, as shown in Fig. 18. Those between stations 1 and 2, and 8 and 9, are tapered, those aft of station 1 are right-angled and fit below the stern blocks and the frame at station 1, while those forward of frame 9 are shaped like the stem.

Three lines, more or less parallel with the keel, will be seen in Fig. 18. The outer one shows the tapered edge of the planks where they run on to the keel, the next or central one shows the edge of the filling pieces, and the shaded space between this line and the inner one shows the extent to which the filling pieces are bevelled.

The position of these lines has been obtained from the sections, as will be appreciated from a study of Fig. 19. As a refinement, I drew sections both horizontally and radially to obtain corresponding points on the lines where they curve upwards at the bow and stern. The portions indicated by cross hatching show the flat surfaces of the filling pieces at their maximum thickness of $\frac{3}{8}$ in.

If the filling pieces are fitted and bevelled carefully to correspond approximately to these lines—allowing a little for final finishing—the work of preparing the hull for planking will be lessened very considerably.

We are now in a position to consider the materials for the construction of the hull. I am not certain about the availability of resin-bonded plywood in the heavier sizes; in a kit for a cabin cruiser I received some time ago, the keel and frames were made of $\frac{1}{4}$ in. five-ply. This was of excellent quality but was not certified as being resin-bonded. However, there are a number of these kits made up and in regular use, and there seems to be no question of the keel opening up, although it is exposed and is subjected to rough usage.

The $\frac{1}{16}$ in. ply for covering the sides and deck of the model was definitely resin-bonded. Just after the war there seemed to be plenty of this about, as it had been left over from Government contracts with the aircraft firms. I think it is still in good supply, especially from the model aircraft firms. I have suggested using it for the deck and bulwarks, and it could be used for the planking.

In the popular Adams dinghy kit of some years ago, the planks were made of this material, and I found it excellent for the purpose. Among other advantages it had no tendency to split. This was, of course, a clinker-built model with planks overlapping.

In the drawings for our model, I have shown the planks $\frac{1}{8}$ in. thick, assuming that pine, cedar, or mahogany planks would be used, but if $\frac{1}{16}$ in. plywood is preferred, this amount must be deducted in drawing the outlines of the sections, instead of the $\frac{1}{8}$ in. shown in Fig. 19. A similar adjustment must be made in bevelling the filling pieces.

But I think it would be better for the beginner to use the thicker wood. He might find it difficult to make a watertight hull with plywood when the planks are fitted edge to edge. On one occasion I used satin walnut for planking a hull. The wood was nice to work, with its fine grain and no tendency to split at the ends. But after it began to dry out the planks shrunk in width, and although the waterproof glue held at the seams, the planks themselves split, greatly to my annoyance. Never again!

● *To be continued*

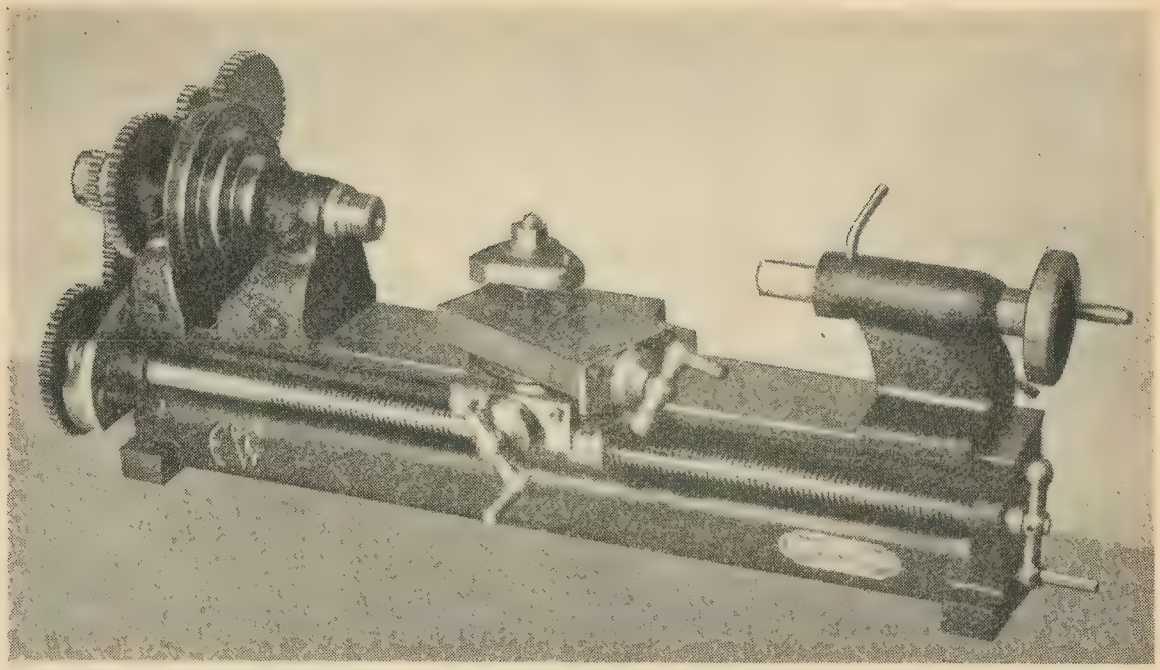
FORTY YEARS OF FORD EXPERIENCE

THE Fordson tractor is now such an integral part of the rural landscape that it requires an effort of will to visualise the agricultural scene without it.

Yet it was only 40 years ago that the first Fordson was shipped to this country. Our picture shows the first Model F arriving at Manchester from the United States in 1917.

Much lighter built than its modern counterpart, it had steel wheels, worm and wheel final drive and a water air cleaner. Petrol or paraffin engines were alternatives, the former developing 23 b.h.p. at 1,000 r.p.m., and the latter, 20 b.h.p. at 1,100 r.p.m.

Since 1933 Fordson tractors have been produced at the enormous Ford works at Dagenham, Essex. ▣



Some modifications to an EW lathe

MARTIN CLEEVE outlines a number of attractive alterations and additions to increase the range of this and similar small lathes

MANY readers have complained that the majority of articles of the "lathe" type centre around machines in the 3½ in. class. I freely admit that their dissatisfaction is justified and that I am partly to blame. However, events have recently conspired in such a manner that I am able to offer a few crumbs in mitigation.

A friend of mine whom I had not seen for some years recently informed me that he now had a lathe—an EW 2½ in. As can be imagined this led to some lengthly discussions and interchange of ideas, and while looking over my modified ML7 he expressed a desire to have similar facilities on his machine: "Gosh, I wish mine was like that" he said. "Why not?" I replied. "Bring it along and I'll give it the once-over."

This proposition was by no means an unattractive one to me. I had often wondered how well a machine of different manufacture would lend itself to some of my ideas, but the problem had always been to find a victim willing to submit his lathe for treatment—and risk the consequences.

In anticipation of the final result having an appearance somewhat different from the original, the first necessary step was to take a "before" picture showing the machine as it was delivered to me prior to beginning operations; this is depicted in Fig. 1, where it will be seen that the machine does not differ greatly in any respect from established practice. The saddle is fully compounded with cross-slide and topslide, the latter being provided with the customary clamp for one tool.

The screw barrel tailstock has the advantage of being of the self-ejecting type, although the full value of this is slightly offset by the limited travel imposed by the ejecting arrangement. In Fig. 1 the barrel is shown in its fully retracted position.

One of the first points to strike me was that the leadscrew had neither clasp (or half) nuts nor clutch for disengaging the saddle at the termination of a screwcutting or self-acting pass. While this is sometimes advantageous when cutting threads which are not exact multiples of the leadscrew it is apt to be rather inconvenient for ordinary cutting by slow saddle traverse, or when threading close to a shoulder; some additional means would be needed to brake and reverse the direction of rotation of the whole set-up.

The headstock is rather novel in that it is composed of two individual members, one for the leading and one for the trailing mandrel support. This, incidentally, is a feature which would delight the heart of the experimental man. Each trunnion is separately locked to the bed and they may be slid apart or brought together to suit almost any kind of headstock gearing arrangement.

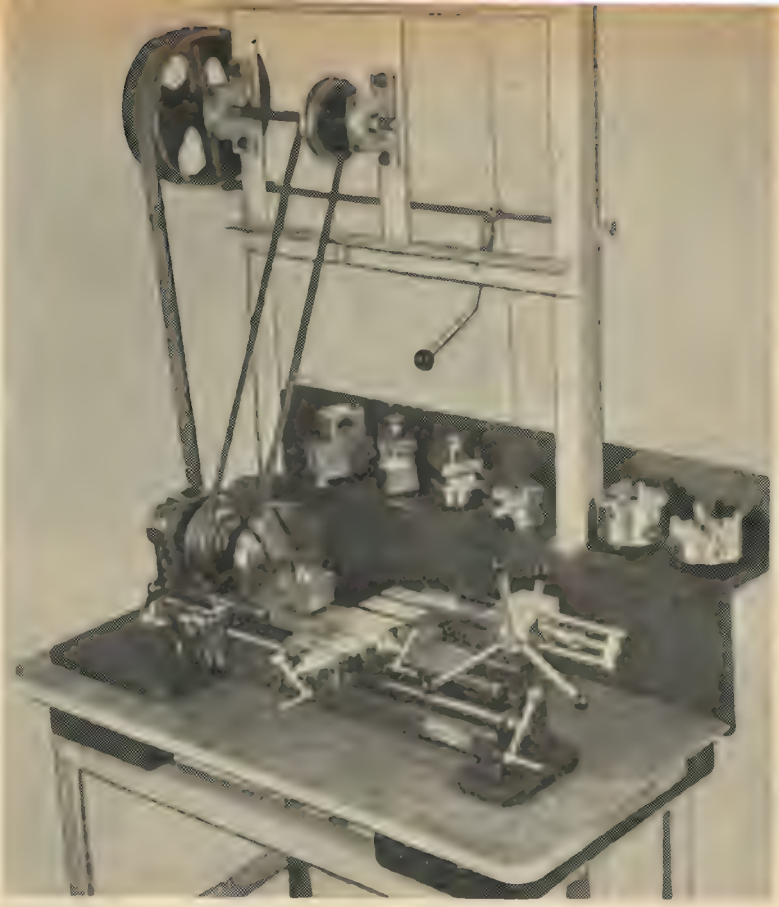
The leading mandrel bearing is of quite substantial length, being 1½ in. Both are split for adjustment and are bored ⅜ in., the mandrel of that diameter running in the cast iron without further bushing.

Before listing the various items made for this lathe I should like to mention the fact that while I carried out all the machining with my own equipment, this does not necessarily mean that the EW owner will be deprived of the pleasure of making a considerable number of them.

My friend, who, as an EW owner, ought to know, is of the opinion that with a little extra contriving, the EW lathe could be persuaded to do nearly everything. Being familiar with some of the astonishing feats of the home mechanic I think this opinion is not without substance. With this in mind, suggestions will be made in their due order.

Admitted there are some jobs which could be carried out only with the help of a larger lathe, but in those cases, I do not think it will be asking too much to suppose that a friend could be found to lend a helping hand.

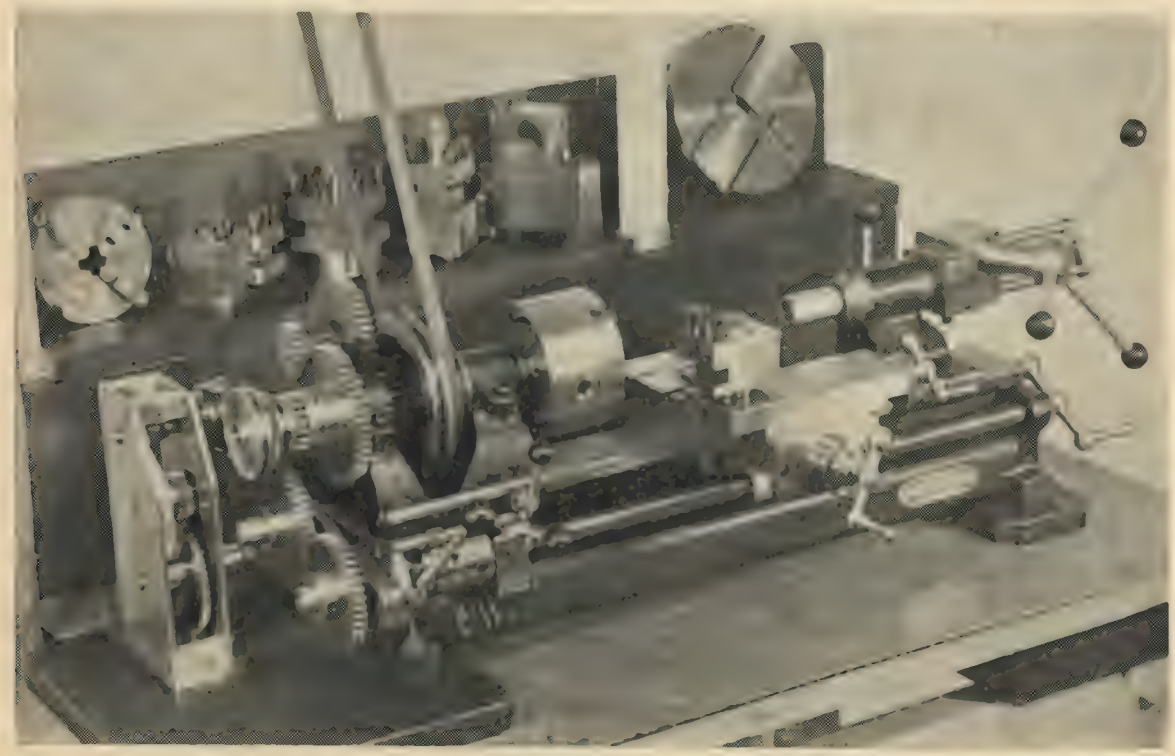
The final result of my intermittent labours over a period of some months may be seen in Figs 2 and 3, and I must confess that the amount of "gadgetry" which it was found possible to add far exceeded my wildest hopes and opened up a new



Left, Fig. 1: *The lathe—as delivered by my friend*

Right, Fig. 3: *A general view of the lathe on its stand with ball-bearing countershaft. The upper lever and rod is for shifting the belt over the fast and loose pulleys*

Below, Fig. 2: *The author's version. The lathe now has a 7 in. T-slotted cross-slide, leadscrew clutch, independent self-act gearbox (extreme left), adjustable saddle deadstop, skew rack ejectin tailstock etc.*



SOME MODIFICATIONS TO AN EW LATHE . . .

and hitherto unexplored field in the practice of fabrication.

Most followers of my notes will be familiar with the fact that I favour the " built up " or fabrication method. In this connection it might be worth mentioning that I do not go so far as to say that castings should fall into disuse, but in my opinion their proper place is either in a factory where they are obviously more convenient and cheaper for production in quantity, or in scale model work where, for example, to build up a railway locomotive wheel would be absurd.

If my memory serves correctly, the first job which I tackled was to fit a single-tooth dog clutch to the leadscrew; this was followed by making a new high-tensile steel spindle of $\frac{7}{8}$ in. main dia. to run in compo oil retaining bushings, the headstock being bored out to suit. This spindle is provided with a ball thrust and has a special flanged nose on to which the various chucks fit by direct mounting. This reduces overhang by about $\frac{1}{2}$ in. and eliminates struggling with obstinate backplates.

The leadscrew nut fitting was modified to give extra forward travel to the cross-slide, the latter being replaced with an all-steel fabricated slide having four T-slots and a useful travel of $4\frac{1}{2}$ in.

The travel of the original topslide was rather limited, so a new one was made. Although this was fabricated from mild steel, readers will, I feel, be interested to note that it is only $\frac{13}{16}$ in. in total thickness. It has a travel of $2\frac{3}{4}$ in. and, in emergency, could be made to travel 3 in.

The satisfactory fabrication of the cross-slide showed the way to what I think will be agreed is a very attractive accessory—a T-slotted faceplate. This may be seen at the top right in Fig. 2. It is just on 5 in. dia. and the slots have the same spacing as those on the cross-slide.

Of course, I was completely unable to resist fitting a skew rack tailstock. This gives a travel of 3 in. to the barrel, which is of silver steel. The rack pitch is 26. The pinion shaft is provided with eccentric bushes to regulate the depth of engagement. The keyway is at the rear of the rack and the key is fitted in the " skew block " so that those who prefer it could have the lever-control handle on top, instead of at the sides as shown.

In between working upon these various items, I made a four-tool turret for direct mounting on the cross-slide, a two-tool rear turret for parting, etc., an adjustable height toolpost for the topslide, a swing-clear boring toolholder—particularly useful as the lathe is without rack and pinion traverse to give rapid retraction of a boring tool to test the progress of a bore—a bushing-type milling arbor steady, a saddle adjustable deadstop rod and a new ball handle for the right-hand end of the leadscrew.

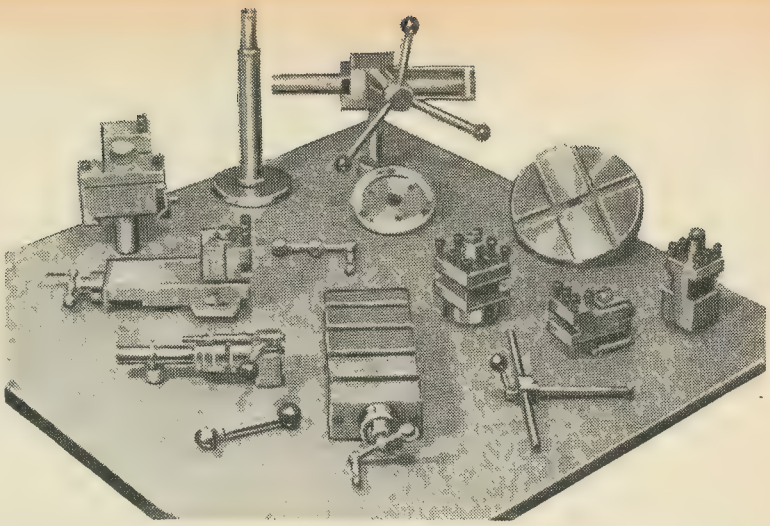


Fig. 4: An orgy of fabrication ! The various components will be recognised from the description in the text

Among the last jobs to receive attention was the making and fitting of an independent self-act reduction gearbox giving quick change to or from screwcutting, building an angle-steel stand, making split ball-race housings for the countershaft subject of an article next week) and, last of all, fitting striking gear and lever for the fast and loose pulley drive. My friend painted the stand and looked after the woodwork side of the job.

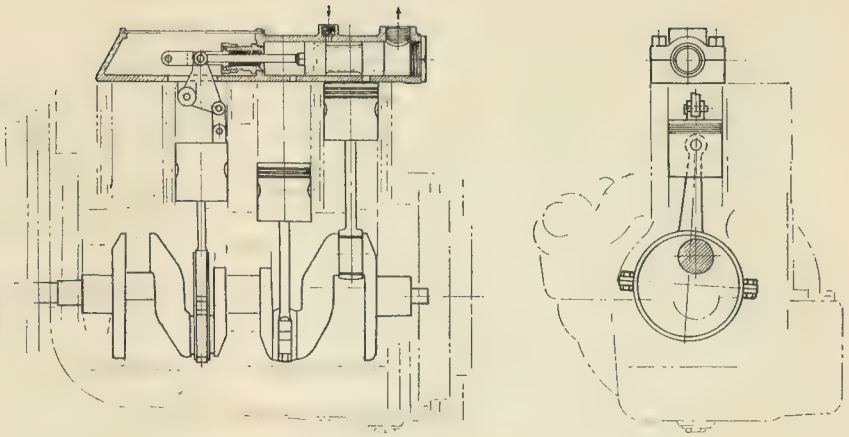
In subsequent articles, after a few notes on the stand and drives, it is proposed to give constructional details of all items, and an attempt will be made to place these in the approximate order of difficulty—starting with the easy jobs, for example, the saddle deadstop, and finishing with those for which it would be more convenient to call in the aid of a larger lathe, such as the skew rack tailstock and T-slotted faceplate.

We have had the lathe on test and the results show that everything is a sound working proposition . . . my friend is about to collect the whole outfit and doubtless will soon report further on his experiences with it; something to which I am looking forward as much as he ! ▣

HOBBIES EXHIBITION

THE thirteenth annual Hobbies Exhibition of the City of London telephone area was held recently. Picture shows Miss E. M. G. Saunders, secretary of the Hobbies Organisation, with two of the first prize-winning models at the exhibition. She is holding a small model of the British-India liner *Kenya*, made by Mr D. A. S. Hughes, an engineer at the City exchange. On the table is a model of a cabin cruiser made by G. E. Thompson, who works at the Monarch exchange, and was a first prizewinner in the youth section.

A STEAM CAR CONVERSION SCHEME



By Edgar T. Westbury

IN VIEW of the recent interest in steam car design, and the possibility of converting existing petrol-driven cars to run on steam, the British Light Steam Power Society has devoted a great deal of attention to the design of suitable power units, capable of being constructed or adapted with minimum complication and expense, which could be fitted to standard types of car chassis.

In the scheme illustrated, an existing car engine can be adapted to run on steam, with no actual alteration of its original components which would necessitate cutting away, machining or drilling, but simply the substitution of certain parts by new parts of simple design, such as could be produced by the amateur constructor without the need for elaborate equipment.

The conversion scheme, designed by Mr M. Harman Lewis, chairman of the above society, may be regarded as similar in principle to that developed by Messrs Bolsover Bros during the war and applied with success to agricultural tractors. In the latter scheme, a steam-engine cylinder block was superimposed over two of the engine cylinders, the pistons of which were converted to serve as trunk crossheads, connected to the steam-engine pistons. Poppet valves were employed, operated by pushrods passing through the existing valve guides, from a special camshaft located and driven in the normal way.

Mr Lewis has very much simplified this arrangement, and reduced the number of new parts required, by using two of the car engine's cylinders as single-acting steam cylinders, with steam distribution by means of a single horizontal piston valve.

The design is based on a Morris 8 Series E engine, but could quite obviously be adapted to practically any orthodox type of car engine. In the drawing, the general outlines of the engine are shown chain-dotted, and only those parts essential to operation as a steam engine are in full lines.

The two rear cylinders of the engines retain their original pistons, with rings, gudgeon pin, etc., and are connected to the crankshaft in the normal way. Pistons and connecting rods Nos 1 and 2 are removed, and a split eccentric sheave is clamped on No 2 crankpin in suitable angular location for timing the valve. The housing for the latter is bolted to the top of the cylinder block, in place of the original cylinder head, and using the same studs, the portion above the two operative cylinders being bored to take the piston valve, with a concentric gland at the forward end of the bore.

On the underside of the valve housing base is a lug which descends into No 2 cylinder and anchors the pivot of a right-angled bell-crank lever, which is connected by a link to a similar pivot lug on a dummy piston operated from the eccentric on No 2 crankpin. This converts the vertical reciprocating motion produced by the eccentric to a near-horizontal arc at the top of the lever, from which double links transmit motion to the piston valve rod.

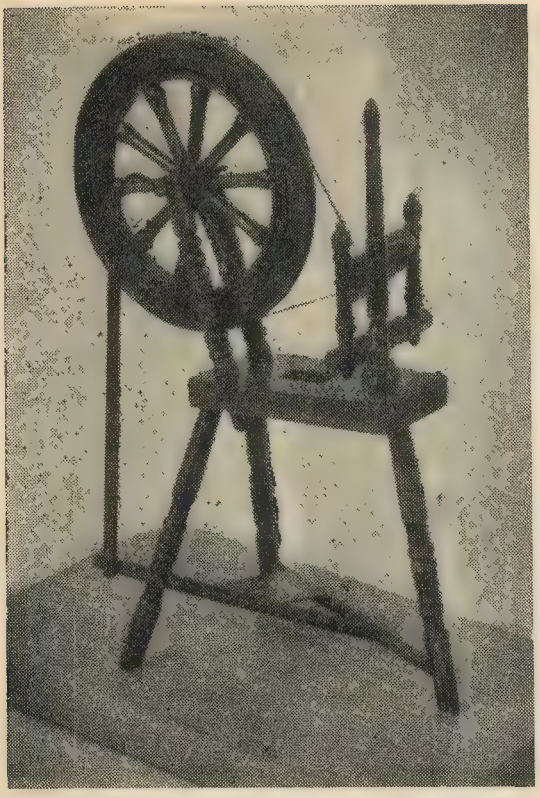
The valve is of the normal inside-admission type, with hollow centre for the passage of the exhaust, and controls distribution to each cylinder in turn, in the same way as in popular types of twin single-acting model engines with which most readers are already familiar. Valve timing is normal, and may of course be varied by shifting the eccentric setting; recommended valve events are as follows. Admission: t.d.c.; cut-off: 33.6 per cent of stroke; release: 78 per cent, and compression: 75 per cent. Suggested alternative setting: admission, t.d.c. + 3 deg.; cut-off, 36.3 per cent ; release 80 per cent; and compression, 78 per cent.

An inspection panel over the valve operating linkage gives free access to the essential parts, and these may be lubricated by oil mist admitted by drilling holes in the crown of the dummy piston, or by a direct oil feed from the main oil system.

The major internal working parts are lubricated in the normal way by the existing engine-driven oil pumps, but it will be necessary to blank off the oil hole in No 1 crankpin to prevent loss of oil pressure. An extra lubricator will be required to supply cylinder oil under pressure to the piston valve. Some adjustment of balance will be desirable, and may be obtained by adding a counter-weight to No 1 crank.

The existing transmission system may be retained, though the clutch is unnecessary, and two gears at most, in addition to the reverse gear, will suffice for all requirements. As a two-cylinder single-acting engine is not positively self-starting, the electric starter may be retained for this purpose.

No details of the boiler, burner, feed pump or other essential parts of the complete plant are included in the scheme, but these will be prepared at a later date, and a good deal of information in the form of working drawings and specification of suitable components is available (to members of the British Light Steam Power Society only). All inquiries regarding the society should be addressed to the secretary, Mr R. Davis, "Lindum," 309 Arundel Street, Portsmouth. ▣

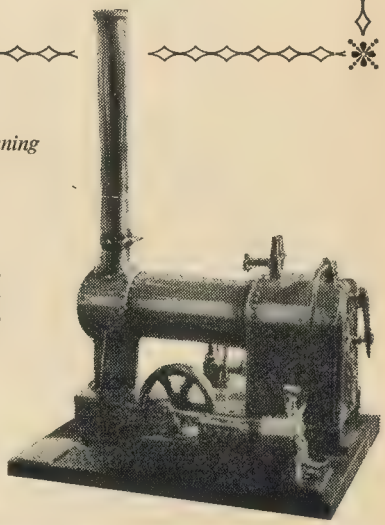


READERS' MODELS

And this time we feature the work of readers from as far afield as Scotland and Tasmania

Left: Mr Corder's spinning wheel

Right and below: Views of the Tasmanian-built horizontal mill engine



MY model spinning wheel, 3⅜ in. high, has been treated in true antique finish.

The wheel can be turned whereupon the foot treadle rises and falls. Quite by accident the wheel squeaks—and this is very much in keeping with the model's antique appearance.

I made the model in 1938, 19 years ago, and I am beginning to feel that it won't be too long now before it really *does* become an antique !

I have since made a replica of the model; this has secured for me a prize of £5 in the Council of Industrial Design competition for Scottish tourist souvenirs.

G. CORDER, Dundee.

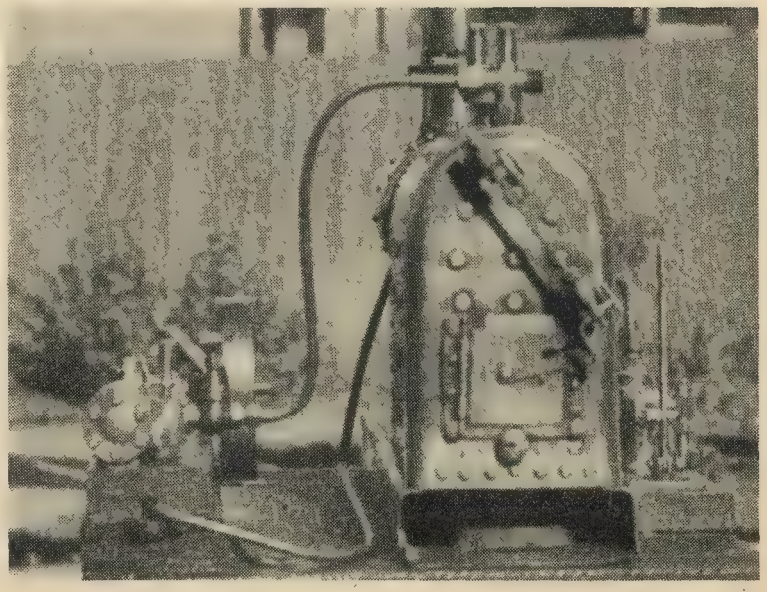
★

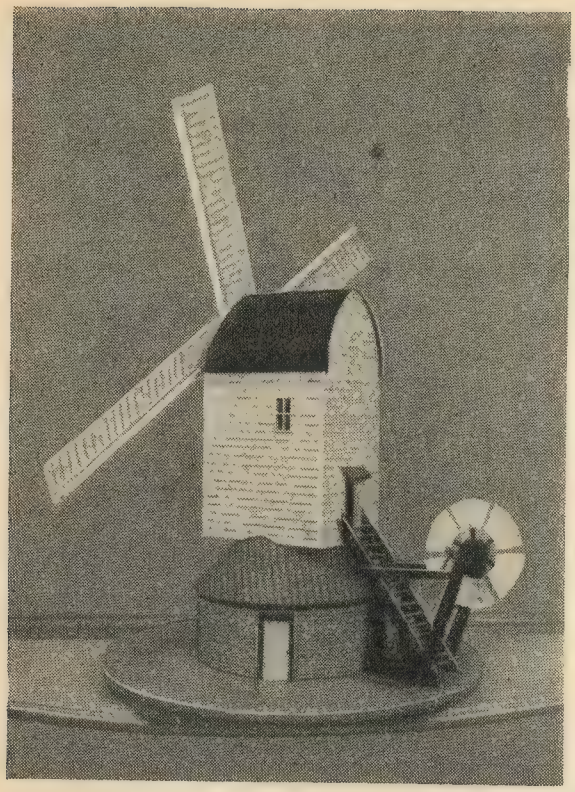
THIS model—not to scale—of a steam horizontal mill engine is of ⅝ in. bore × 1 in. stroke and works at 60 p.s.i. pressure.

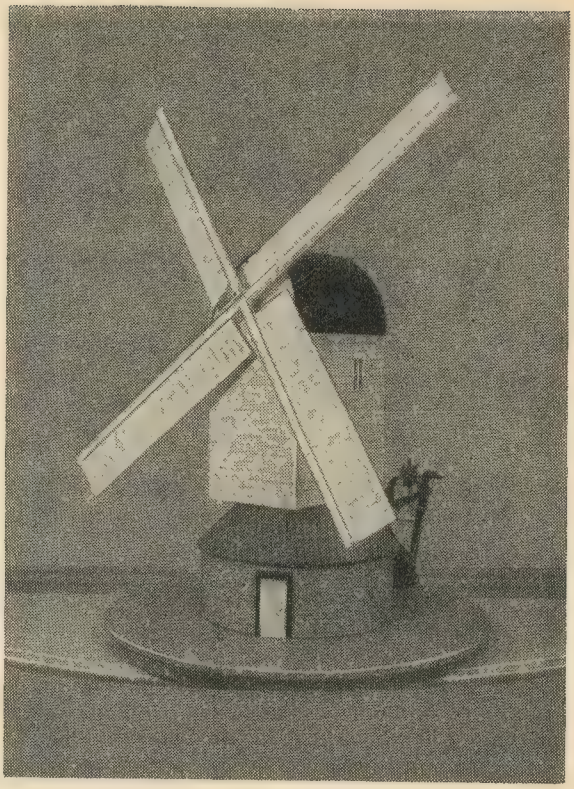
The boiler is all brass with the usual fittings, excepting a pressure gauge. It is fitted with seven ½ in. brass tubes and is a good steamer. It is soft soldered and copper riveted, and has water-space and longitudinal stays and twin safety valves. Working pressure is 60 p.s.i.

The boiler feed pump is ⅜ in. bore × ¾ in. stroke (hand type) fitted with 3/16 in. delivery and suction pipes. It was built from scrap material.

T. S. FOON, West Launceston, Tasmania.







Two views of Mr Scott's model windmill

THIS model of a post-type windmill is to a scale of $\frac{1}{8}$ in. to one foot.

The mill house is of wood and has been made to represent weather boarding. The round house below is of sheet aluminium covered with brick and tile paper, the whole being fixed to a wood frame with a centre post carrying a length of steel tube into which works a $\frac{3}{8}$ in. brass spindle attached to the mill house—thus allowing it to rotate in a circle.

The small wheel mounted over the steps is the fantail and, being at right angles to the sails, keeps these always into the wind. Should the wind veer, it will rotate this wheel which, in turn, through reduction gear 15 to 1, would rotate a wheel mounted under the steps; this would move the mill until the sails are again into the wind.

The sails are of aluminium fixed to hard wood arms with a $\frac{1}{4}$ in. brass spindle 4 in. long working in a brass tube. The distance across the sails is 31 in. and the total height of the mill is 23 in.

The only departure from the original is the fitting of only one wheel under the steps, whereas in practice I believe two are fitted in tandem fashion.

G. M. SCOTT, Clacton-on-Sea.

AN OSCILLATING ENGINE OF 1854

COMING across a drawing of an oscillating engine on a pillar by the late Mr Muncaster recalled to my mind an illustration I had seen in a mechanics' journal for 1854.

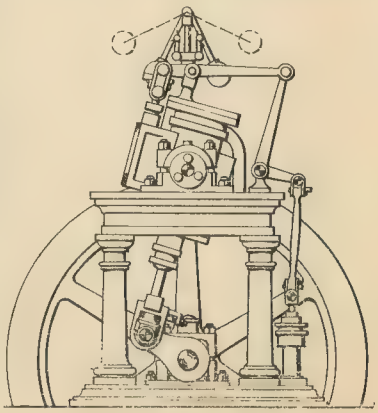
The engraving is too thin to be reproduced, so I have drawn the engine as it was shown. Observe the four turned pillars and the action of the valve gear which is actuated from a bracket on the top cover of the cylinder and a bell-crank lever, the short end of which drives the boiler feedpump.

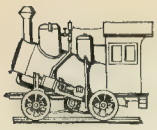
It would be quite in order to work out a valve motion with an anchor link only, omitting the feedpump, and be able to describe such an engine as complete—because often a factory contained several such units supplied from one boiler for stirring hot liquids in vats, etc., the exhaust steam helping the heating of the chemicals being mixed.

These engines were quite small; the type was built as a rule of from one-half to four horsepower or so; the example illustrated was built by W. C. Moreton of Hope Iron-foundry, Burnham, Buckinghamshire. Date: July 1854.

Anyone who wanted to make a model of it must be very careful regarding the governor; a plan must be drawn to work out where this can be placed on the entablature so that the balls can rise freely without fouling the valve lever at its highest point.

H. H. NICHOLLS.





UNUSUAL LOCOS

The Heisler geared locomotives

By ERNEST F. CARTER

Though some of the oldest railway locomotives had gear transmission, its use was abandoned at an early date in locomotive history, and it was not until the middle Eighties that it was re-introduced in various forms for special services, particularly on the American continent.

Geared locomotives were also used in Germany in the early 1930s. They were used in conjunction with coupling-rods for the purpose of reducing the rigid wheelbase of 10-coupled engines, of which the four leading axles were coupled by side-rods in the usual way, while the fifth was driven therefrom by means of gearing.

The first Heisler locomotive was built by the Stearns Manufacturing Company, of Erie, Pennsylvania, and was delivered on 20 August 1894 to Read and Campbell, of Patzcuaro, Mexico; six years later the same firm produced a 60 ton engine of which the hauling capacity was no less than 2,965 short tons.

It was built for the McCloud River Railroad, which was a 20 mile line located at the foot of Mount Shasta, Siskiyou County, California; on which the main-line curves were of 383 ft radius, and those of the spurs into the logging forest as acute as 190 ft. Gradients of 1 in 25 and 1 in 50 were also common on the line.

In general appearance the Stearns-Heisler locomotive resembled a Fairlie in that the engine was carried on two four-wheeled bogies of which all eight wheels were driven, but it differed inasmuch that the four wheels under the tender were also coupled and driven.

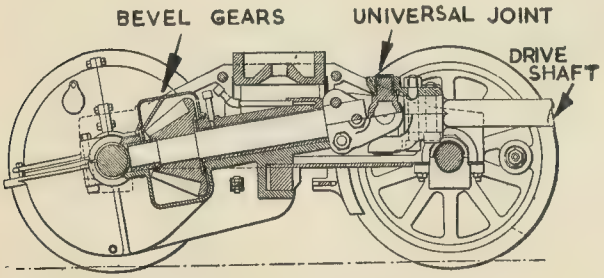
Power was supplied by a pair of diagonal engines with 18 in. × 15 in. cylinders placed crosswise under the boiler and driving on to a 7 in. dia. crankshaft lying between the frames and parallel to their longitudinal centre line. Both cylinders drove a single crank in the manner customary with diagonal engines.

There were five shafts coupled up in one length beneath the boiler of the locomotive; first the crankshaft, and then at each end of it were two other shafts with two Hooke universal couplings, which connected them to each end of the crankshaft and by which power was conveyed to the leading axle of the front bogie and to the trailing axle of the rear truck.

The end piece of shaft in each case had a squared end on which the universal joint was bolted, and the shafts themselves were inclined slightly to enable the intermediate length of shaft to clear the other axle of each bogie; the intermediate shaft having no bearings and thus allowing the bogies to swivel as the track radius exigencies required.

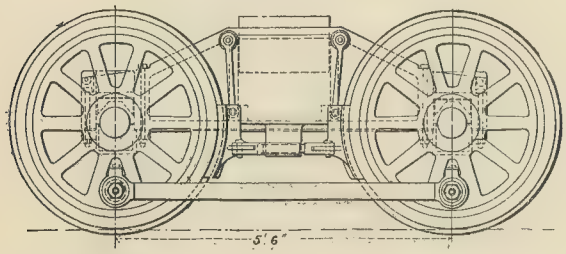
A second system of shafting was required to drive the tender wheels. On the crankshaft was mounted a gearwheel which meshed with a similar wheel placed above it; these wheels were not spurwheels but very long cones which drove an inclined shaft beneath the firebox and cab floor. This shaft also had universal-jointed ends and was coupled to two other shafts in the manner already described. Both these joints are visible under the tender.

The Heisler locomotives differ from

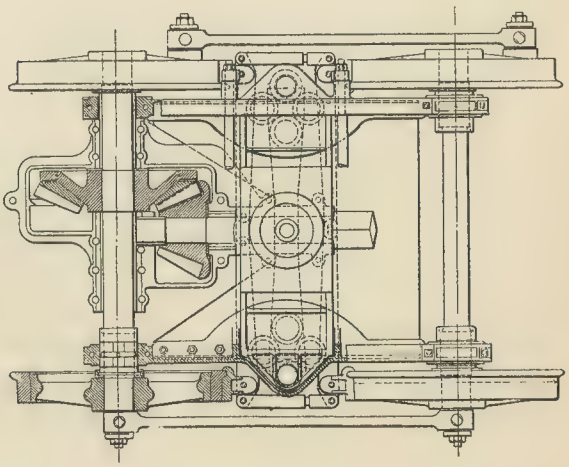


Left: Longitudinal section of bogie showing gears and universal joint

Below: Side elevation of bogie



Below: Plan of bogie



other geared types, such as the Shay and Climax, in that the transmission was effected by both gears and side coupling-rods, the 3 ft 4 in. dia. wheels of each "motor" bogie having usual connecting rods, and one axle only of each bogie being actuated through bevel gears from the engine-driven longitudinal transmission shaft. This arrangement obviously reduced the number of gears to half that used in the Climax and Shay engines without reducing the locomotive's flexibility.

Built to operate on 4 ft 8½ in. track, the Heisler 60 tonner weighed another 10 tons when carrying a full supply of fuel and water, and measured 45 ft 9 in., of which the total wheelbase was 37 ft; the maximum rigid wheelbase (that of each bogie) being only 5 ft 6 in. Overall height was 13 ft 2 in., and the 4 ft dia. boiler was carried with its centre line 7 ft 11 in. above rail level, and contained 188 × 2 in. dia. tubes 11 ft in length. The firebox was 3 ft 9½ in. high and 4 ft in width, with an inside length of 6 ft 9½ in. The working boiler pressure was 170 p.s.i.

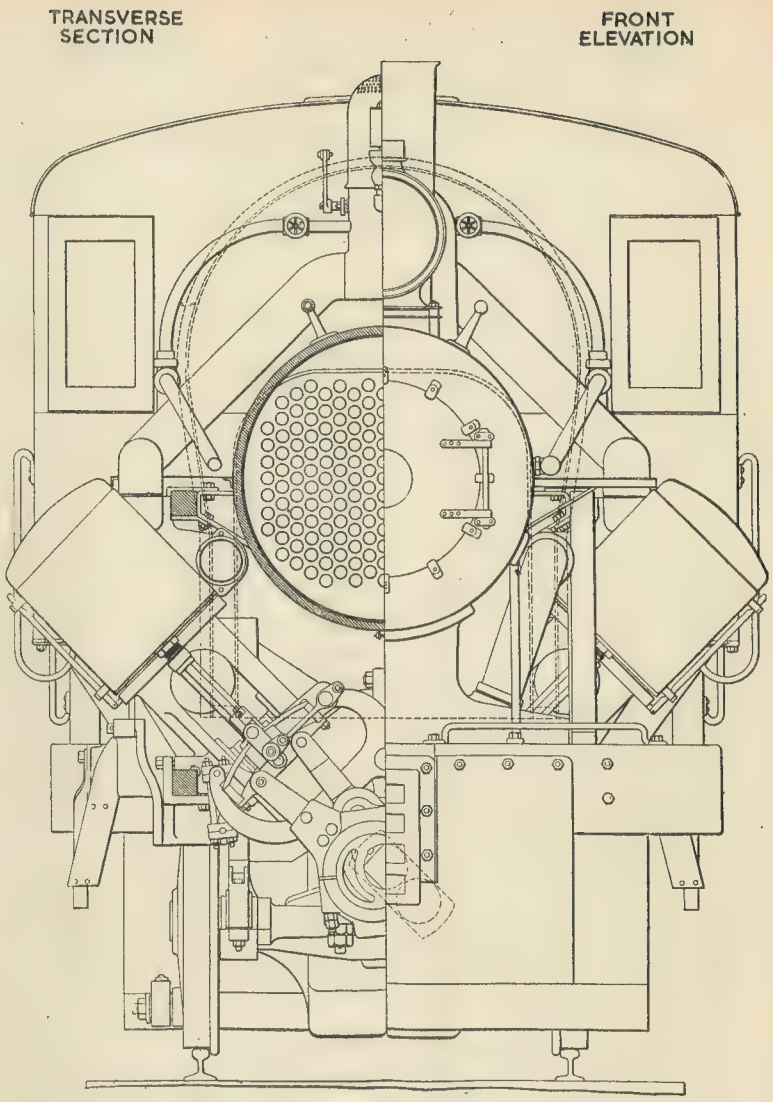
At one time the McCloud River Railroad was worked by two locomotives, one of which was a 60 ton normal Mogul rented from the Southern Pacific Railroad, and the other a Heisler of the same weight, but while the Mogul would regularly haul a load of four cars totalling 120 tons at an average speed of 6 m.p.h. up a four per cent gradient, the Heisler could handle at the same speed up the same gradient, six cars totalling 180 tons; this test being made on dry rails.

Greater starting power

On wet rails, the Heisler engine had further advantages because of its greater starting power and tractive effort, and continued to haul the six-car load, whereas the normal Mogul could haul only three cars at no greater speed than the Heisler hauled the heavier train. The deficiency of the Mogul was largely due to driving-wheel slip. The down-grade speed of all trains was limited to 12 m.p.h., but they often ran at from 15 to 20 m.p.h., although such a speed was strictly forbidden as unsafe.

The Heisler engines were designed to burn wood, of which fuel there was an abundance on the site of the line, and with good hardwood they would exert a tractive force equal to one-fifth of their weight at a speed of 5 or 6 m.p.h. under a full load.

As the driving wheels were devoid of counterbalance weights, there was no hammering action on the rails, and the loading per axle was thus made higher than in the case of an ordinary locomotive, while, as the rail wear was less, track maintenance was reduced. ▣



Above: These views illustrate the unusual layout of the cylinders and motion

Below: The Heisler locomotive used by the McCloud River Railroad

Some simple aids to photography

By BRITTANICUS

THOSE who are camera-minded and members of local model engineering clubs are often persuaded, as I am, to photograph the other man's models !

Of course, the best way of all is to use a plate camera—about half-plate size—with treble extension, swing back, rising front, and all the rest of the aids to success. If you are like me, you cannot afford such an instrument and must be content with a simple folding roll-film camera. But good work can be done with this type of apparatus aided by supplementary lenses and a little care in measuring distances.

For success, one must stop down considerably to obtain sufficient depth of focus, and this entails time exposure and a *steady* tripod. (Once, while photographing at our local exhibition, I forgot the floor was a sprung dance floor, and fellow members came prancing by just as an exposure was being made—with dire consequences !)

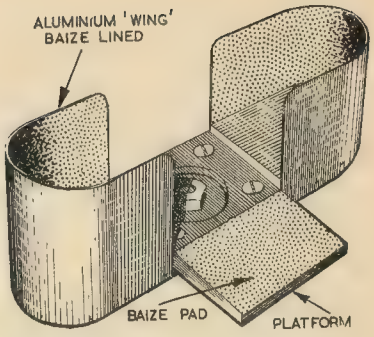
CAMERA SHOE

If one can obtain an old-fashioned wooden tripod, the best method of securing the camera to it is to use a camera shoe, which can be made quite easily. It must be tailor made to suit one's camera.

I traced round the outline of the body of the camera and cut out a piece of wood to the outline obtained. Then I drilled through the exact centre to take the tripod screw. This, being British, was threaded $\frac{1}{4}$ in. Whit. As I normally use a $2\frac{1}{4}$ in. square Agifold, I raised the ends above the centre of the wooden base to clear the screw.

Two wing pieces were made from some aluminium sheet, obtained from a kitchen disaster ! These were then lined with green baize stuck down with balsa cement, and screwed into place. Also, an extension piece was attached to the front in such a way that the camera front rested lightly upon it when open. This has proved itself in use, and it is now my intention to make another to fit the 35 mm. Retinette which is used for colour.

The tripod is of some slight interest. It was of the turntable variety, but the turntable was incomplete. A piece of hardwood was turned to $5\frac{1}{2}$ in. dia. on the faceplate of the ML4 and to the underside of this was screwed the lug ring into which the legs clamp.



Top: The baize-lined cradle for holding the camera

CAMERA CLAMP

I spend a great deal of my spare time on landscape work, especially among the mountains. A fence or a gate can often serve as a useful support for the camera provided some form of clamp is available.

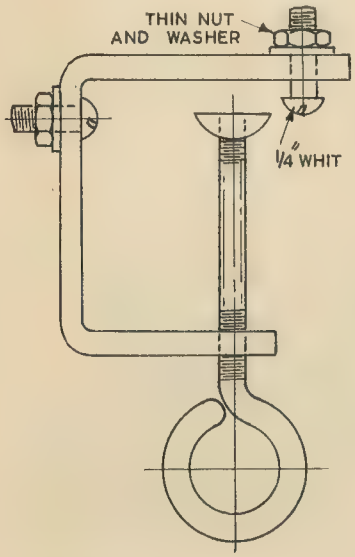
My clamp was made from an old handicraft clamp, by simply drilling two holes, as shown in the sketch, tapping them $\frac{1}{4}$ in. Whit., and fitting them with a suitable bolt and nut. In order to adjust the camera to position it was found necessary to insert a thin washer below the nut. This was filed to a suitable thickness. Such a clamp saves much effort—a telescopic tripod was once carted all the way over Striding Edge and Helvellyn, for some 12 miles, and used once !

SMALL TABLE TRIPOD

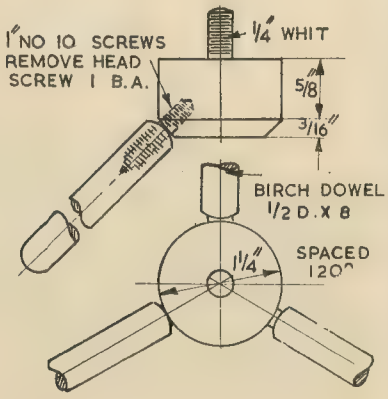
In model photography, it is often necessary to place the camera in some position in which a normal tripod cannot be used, as on a model railway. Hence, a table tripod is a great help.

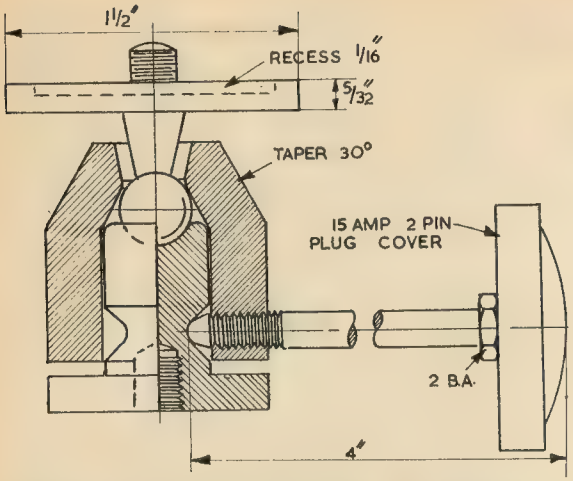
An odd end of $1\frac{1}{4}$ in. dia. b.m.s. rod was chucked in the three-jaw and faced at each end. It was then centred and drilled from the tailstock with the tapping size drill for $\frac{1}{4}$ in. Whit. The work was tapped $\frac{1}{4}$ in. Whit., also from the tailstock. This could be drilled and tapped right through and a bolt fitted, but in practice a blind hole was drilled and a piece of suitable threaded rod screwed in after being coated with Metal Fix.

The other face was dealt with and then the edge was chamfered as shown. Because this was made out of a small scrap piece, and there was no urgent need, the chamfer was kept small. By using the jaws of the three-jaw as a dividing plate the chamfer was centre punched at 120 deg. intervals. Using a machine vice clamped to the boring table with a Heath Robinson arrangement of packings and clamps, blind holes were



Below: Details of the clamp and the table tripod





The ball-and-socket head

drilled and tapped 1 BA for the legs.

The legs were made from ½ in. birch dowelling, and were shaped by hand. The upper end was fitted with a No 10 woodscrew in each case. These were then removed and, after beheading, were threaded No 1 BA to fit the holes. They were then replaced in the ends of the legs, so that the legs are readily removable.

Some time ago, I bought a commercial ball-and-socket head and used it for a considerable period without much trouble, except that it was difficult to operate the locking screw under the camera as it was short. Moreover, the head would not unscrew readily from the Agifold, and this caused much thought.

One obvious remedy for the first fault was to make a long rod, with a suitable knob at one end and a screw at the other, to replace the short screw. This was not done immediately, but a further trouble soon developed. The head was made of light alloy—dural, I believe—and this is notoriously greasy. It is not funny to the photographer to see, in the course of a time exposure, his camera droop like the proverbial lily and finally direct itself to the floor!

Accordingly, a piece of b.m.s. 1¼ in. round bar was obtained and the head was to all intents rebuilt. The design employed was in the main, that of the commercial article. The bar was chucked in the three-jaw, and supported on the back-centre also. It was then skimmed and faced, and a piece 1 3/16 in. was parted off. The piece was placed in the three-jaw, centred and drilled from the tailstock with a ¼ in. drill to form a pilot hole.

This was opened out to ½ in. by drilling and bored to ⅝ in., being taken to a depth of ¾ in. The workpiece was reversed in the chuck and, with the topslide set over to 45 deg. the hole was taper bored as shown after drilling out to ⅝ in. at upper end only. The topslide was altered to give a 30 deg. taper and the bore was tapered inside to this setting, as shown.

A very small boring tool was used here and it was necessary to take only very light cuts, for obvious reasons.

With the tool replaced by a round-nosed tool, the outer taper was turned to the same taper, a fine finish being obtained by a light cut with a round-nosed and very sharp stellite tool-bit held in a standard holder. The internal taper was used to clamp the ball firmly when the core was forced against it by the locking screw.

A further piece of b.m.s. rod was chucked and turned down to a sliding fit in the bore of the above for a length of 11/16 in., leaving a shoulder. The end was hollowed out, using the topslide and cross-slide feedscrews. It was parted off, giving a total length of ⅞ in. The work was reversed in the chuck, centred and drilled and tapped from the tailstock ¼ in. Whit.

From an odd piece of round b.m.s. from the scrap-box a disc 5/32 in. thick was parted off, having been recessed 1/16 in. first. This recess is not absolutely necessary, but it can be used to hold a disc of felt; this should prevent the camera locking to it—if the disc does not disappear, as mine always seems to do! The disc was drilled and tapped ¼ in. Whit.

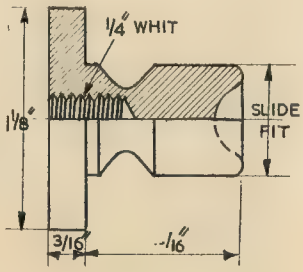
The ball was hand turned from a piece of suitable brass rod from the scrapbox, the ball being ⅝ in. dia. The shank was turned to ¼ in. as illustrated in the general design, with a taper as shown. The upper end of the shank was screwed ¼ in. Whit.

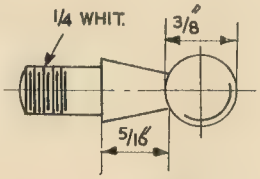
Finally the case was drilled through the side and tapped 2 BA. The items were assembled temporarily and the core marked through the tapped hole. It was then removed and rechucked in the three-jaw and a groove, more or less V-section, was turned in it so that the locking screw would act on the upper slope of the groove and force the core toward the internal taper of the case, thus locking the ball.

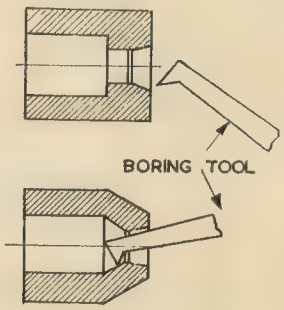
The locking rod was made from silver steel and after screwing both ends 2 BA, one end was tapered and hardened. This end was entered into the case. A discarded 15 amp two-pin plug provided a useful knob. This was fastened to the other end by a locknut.

The head has now been in use for some time and has none of the troubles of the original. It will probably be fitted with a long locking rod, and possibly a new mild steel outer case may be fitted with the internal taper described. It will then be used in conjunction with the camera clamp, on outside occasions. ▣

The core, ball and method of boring







ZOE

LBSC now explains a way of getting the maximum of boiler feed pump into the minimum of available space

Continued from 13 June 1957, pages 858 to 860

WHEN designing and building a little locomotive intended for real work, one of the biggest headaches is the need for making every part substantial enough to stand the racket, and at the same time fit it into the space available without turning the engine into a freak.

Although some folk still dispute it, Nature refuses to be scaled, and many times in my long experience I have been faced with the task of "getting a quart into a pint pot" as the old saw puts it. The boiler feed pump for the 1¾ in. gauge passenger-hauler is a case in point. A pump big enough to feed a boiler virtually as big as that on a 2½ in. gauge Pacific-type engine is needed, but there is only 1⅞ in. between the adjacent coupled axles and 11/16 in. between the axleboxes and inner faces of the hornblocks in which to put it.

A position ahead of the coupled axles is right out of court owing to the steam and exhaust pipes, and in any case this would mean inordinate length of water pipes. The boiler sits low almost on top of the frames, so inclined pumps (as I fitted to my 4-12-2) are also out of the question. However, a glance at the drawings will show how the problem was overcome.

The pump is of a special type with a long valvebox which enables the ram to go right back into it between the valves, and this allows the use of a pump barrel of minimum length. By setting the pump at a level which just allows the bottom of the ram to clear the intermediate axle at its highest position together with the aid of an eccentric rod with a set in it, it is possible to drive the ram from an eccentric mounted on the driving axle. The angularity of the drive isn't sufficient to cause unnecessary friction—and, anyway, the amount of bearing surface between the ram and the gland and pump barrel is quite enough to counteract the slight upper thrust, as I have found on my own engines.

The pump is carried by a separate stay (already illustrated separately) which is erected as close to the leading hornblocks as possible, bringing the pump valvebox within a bare ⅛ in. of the axle. It would be quite possible to cast the pump stay, barrel and valvebox as a single unit; and with a chucking-piece cast on opposite the barrel, would be quite simple to machine.

PUMP BODY

The pump body may be made from a casting or built up, as desired. If cast, there will be a chucking-piece opposite to the barrel. Chuck one end of the valvebox in the three-jaw, and set the other end to run as truly as possible. Face the end, centre, and drill right through with No 24 drill. Open out and bottom to a full 5/16 in. depth with a 9/32 in. drill and D-bit, slightly countersink the end and tap it 5/16 in. × 32, taking care to avoid spoiling the valve seating.

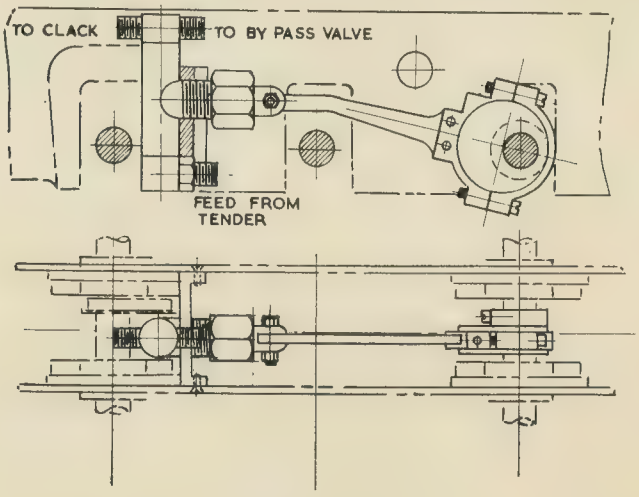
Chuck a short bit of ½ in. rod, turn down ⅛ in. of it to 5/16 in. dia. and screw it 5/16 in. × 32; screw the valvebox on to this, and repeat operations on the other end. Note there is no need to use the D-bit. Instead, cross-nick the bottom of the hole with a little chisel made from a short piece of 3/32 in. silver steel filed to shape and hardened and tempered to a dark yellow. It saves time if a few of these little gadgets are made in various sizes and kept handy for use as required.

Next, grip the chucking-piece in the three-jaw and set the barrel to run as truly as possible; face the end, centre, and drill in about ⅛ in. depth with 5/16 in. drill. Put a 5/16 in. D-bit in the tailstock chuck and enter this into the short drilled hole in the barrel, then very carefully feed it in until it breaks through into the hole through the middle of the valvebox.

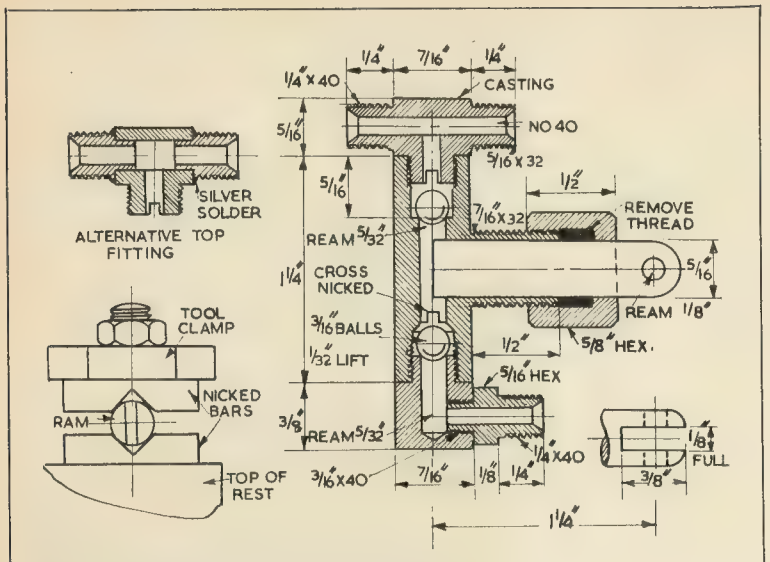
Carry on until the D-bit crosses the hole and touches the other side of it. This is preferable to using a 19/64 in. drill and 5/16 in. reamer on this job, as the drill would form a countersink perilously near to the side of the valvebox and the "lead" end of the reamer wouldn't allow it to go in far enough to form a parallel bore for the full length of the barrel.

Turn the outside of the barrel to 7/16 in. dia. right up to the valvebox, and screw it 7/16 in. × 32. Note this must be a tight fit in the tapped hole in the pump stay, so adjust the die in the tailstock holder to "cut large" when first screwing, and try the pump stay on it. Face the end of the barrel to exactly ½ in. from the valvebox. The chucking-piece can then be sawn off and the stub filed smooth.

For a built-up pump body, use a piece of 7/16 in. round rod for the valvebox; bronze or gunmetal if available, but brass will do at a pinch. Face off to 1¼ in. length, then machine both ends as described, simply reversing in the chuck to do the second end. For the barrel, use a similar piece of rod, which can be held in the chuck to face off, centre, and drill



Erection of the pump



Section of the pump and—a beginner's tip—how to hold the pump ram for slotting

as instructed. Put the D-bit in to about $\frac{3}{8}$ in. depth. Incidentally, D-bits are champion for boring long true holes; my late friend Mr Cecil Purdey, who was head of the gunsmith firm of that name, told me there was nothing to beat them for boring gun barrels.

I bored cylinders with home-made D-bits well over half a century ago on a wibbly-wobbly lathe without any slide rest (that was some time before I had my first Drummond) and they came out all right.

Screw the outside of the bored rod $\frac{7}{16}$ in. × 32 for $\frac{1}{2}$ in. length, taking the same strict caution as before to make it fit tightly in the tapped hole in the stay, then part off at $\frac{3}{8}$ in. from the end. The plain end must then be recessed out to fit the curve of the valvebox, and the easiest and quickest way to do this, if a $\frac{7}{16}$ in. endmill is available, is to put the endmill in the three-jaw and clamp the barrel under the slide-rest toolholder at centre height. Next, run it up against the side of the endmill, which will cut the half-round recess an exact fit in about the same time as it takes me to set down these instructions.

Failing an endmill, use a little fly cutter, the same as described in the instructions for making cylinders for the children's locomotive, using a $\frac{5}{16}$ in. holder with $\frac{1}{8}$ in. cutter. Alternatively, the recess can be filed with a $\frac{3}{8}$ in. round second-cut file.

Several beginners have asked how to hold round stock under the slide-rest toolholder tightly enough to prevent slipping, yet without damage. Simple! Just get two short pieces of square brass rod and file a V-nick in each, to a depth of about one-third the diameter of the piece you want to grip. Put one above and the other below the round stock, so that it rests in the vees, then put the lot in the toolholder and tighten the clamp.

I use this ruse for holding round work in the machine vice on my milling machine; I made a small pair of extended brass V-blocks specially for the job. For holding small-diameter round stock in either machine or bench vice, I just drill a hole in a short piece of bar, make a hacksaw cut in one side right through to the hole, put the round stock through the hole, and grip the bit of bar in the vice. The sawcut allows it to spring sufficiently to grip the round stock without either movement or damage.

Getting back to the pump job, put the valvebox centrally in the recess in the end of the pump barrel, tie them together with a bit of thin iron binding wire (the kind used for tying up bunches of flowers is what I use) and silver solder the joint. Pickle and wash off; then put the $\frac{5}{16}$ in. D-bit in the drilling-machine chuck, push the barrel on to it as far as it will go, hold the valvebox in the machine vice on the table, and carefully run the D-bit right through into the valvebox until it touches the opposite side of the centre hole. You then have a pump body just the same as the casting. Finally, poke a 5/32 in. parallel reamer through the central hole in the valvebox, whether cast or built-up, to true the ball seat and remove any burring.

FITTING VALVES

Drop a $\frac{3}{16}$ in. rustless ball in the D-bitted end of the valvebox and seat it in the usual way by putting a bit of brass rod on it and giving one sharp crack with a hammer; then take the distance from the ball to the top of the box. The double-union T-fitting can be cast or built up; if cast it will be in the form of a cross. Chuck by one projection, set the opposite one to run as truly as possible, face off, centre deeply with size E centre-drill, drill right through with No 40 drill, turn down $\frac{1}{4}$ in. of the outside to $\frac{1}{4}$ in. dia. and screw $\frac{1}{4}$ in. × 40. Reverse and rechuck in a tapped bush, then turn and screw the other end likewise, countersinking the hole deeply with the centre drill.

Chuck by one of the other projections, setting the outer end as true as possible. Face the end, centre, and drill with a No 40 right into the hole previously drilled. Turn the outside to $\frac{5}{16}$ in. dia. and screw $\frac{5}{16}$ in. × 32. Face off until when the piece is screwed home, the ball will have approximately 1/32 in. lift, then cross-nick the end as shown. The chucking piece can then be cut off and the stub filed smooth.

To build up the fitting, chuck a piece of $\frac{7}{16}$ in. rod in the three-jaw, face, centre, and turn down the outside to $\frac{5}{16}$ in. dia. for a length 1/32 in. less than the distance from ball to top of valvebox. Screw $\frac{5}{16}$ in. × 32, drill No 40 for $\frac{3}{8}$ in. depth and part off $\frac{5}{16}$ in. full from the shoulder. Drill a 5/32 in. hole right across the middle of this, and silver solder a $\frac{1}{4}$ in. × 40 union nipple into each end. When either the cast or built-up 'T' is screwed right home, the union nipples should point fore-and-aft, as our nautical friends would say, lining up with the pump barrel.

For the bottom fitting, chuck the $\frac{7}{16}$ in. rod again, face the end, and turn down $\frac{3}{16}$ in. of the end to $\frac{5}{16}$ in. dia., screwing $\frac{5}{16}$ in. × 32. Centre and drill No 24 for $\frac{7}{16}$ in. depth. Put a 5/32 in. reamer in as far as it will go. Drop a $\frac{3}{16}$ in. ball in the valvebox, take the depth as before, then face off the end of the fitting until the screwed part is a bare 1/32 in. less. Part off at $\frac{3}{8}$ in. from the shoulder.

Screw the fitting home temporarily in the bottom of the valvebox and make a mark exactly under the pump barrel. Remove it, centre and drill a 5/32 in. hole at the marked spot, tap it $\frac{3}{16}$ in. × 40, seat the ball on the end of the longitudinal hole and screw the fitting home.

Screw the pump barrel into the stay; it should be vertical and quite tight when right home. Make another $\frac{1}{4}$ in. × 40 union nipple from $\frac{5}{16}$ in. hexagon rod as shown, and screw it into the tapped hole in the bottom

fitting. A smear of plumber's jointing can be used on all the threads, but take care that none gets inside the valvebox, for obvious reasons !

GLAND AND RAM

The ram can be made from a piece of $\frac{5}{16}$ in. rustless steel or drawn bronze rod, which should be a nice sliding fit in the barrel, and will need no turning. At $\frac{3}{8}$ in. from the end drill a cross-hole with a No 34 drill. Chuck the rod with this end outward, round it off, then part off at $1\frac{1}{4}$ in. from the centre of the hole. Clamp the ram under the slide-rest toolholder and run it up to a $\frac{1}{8}$ in. saw-type cutter on a stub mandrel held in the chuck, and cut a slot $\frac{3}{8}$ in. deep.

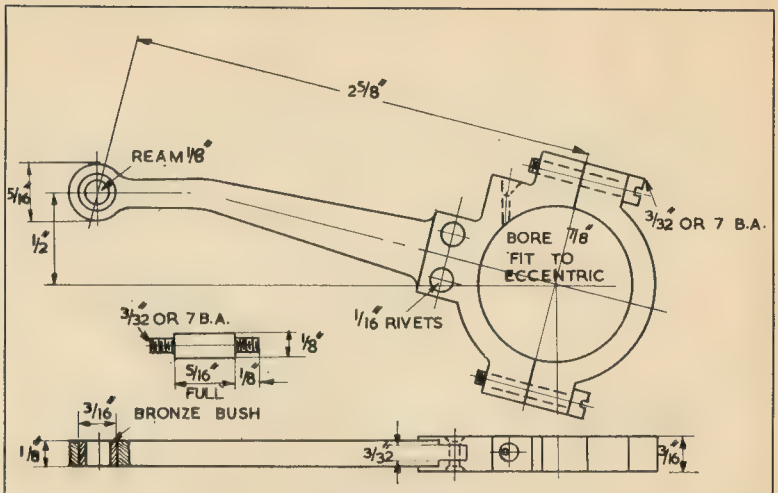
My pet scheme for quickly setting the ram truly before I had a milling machine, was to put the No 34 drill in the chuck and hang the ram on it. The rest was then run up to the chuck, the ram swung around until it rested on the tool seat, the bits of bar with the Vs in them (previously mentioned) placed above and below it, and the clamp tightened. A bit of packing was put under the lower piece of bar to bring the ram horizontal at lathe centre height. The drill was taken out of the chuck, the cutter put in, and I went ahead and cut the slot dead true in two wags of a dog's tail. Tricks in every trade ! Ream the cross-hole $\frac{1}{8}$ in.

The gland is merely a glorified union nut made from $\frac{5}{8}$ in. hexagon rod by the process described for small ones, but there are two points to observe. One is that the threads must be fairly tight; if they aren't and the gland slacks off when the engine is running fast, something is going to happen underneath, and mighty quick at that. I've seen the results of a similar happening on a full-size engine—nuff sed !

Secondly, by the good rights the pump barrel should have been larger outside, which would have given more space between the ram and threads for packing; but the diameter of the barrel was restricted by the available space, and to reduce the diameter of the ram would have lowered the amount of water delivered by the pump. However, more space for packing can be obtained by chucking the gland in the three-jaw and boring out the inner half of the threads.

ECCENTRIC STRAP AND ROD

A wee boring-tool made from the tang end of a worn-out square file is just the right tool for jobs of this description. A few strands unravelled from a piece of full-size pump packing is the best stuff for the little gland; failing that, use graphited yarn.



Eccentric strap and rod

The eccentric strap is machined up from a casting. Smooth off the outside with a file if needed, then scribe a line across the lugs. Centrepop both lugs and drill them No 48. Put the casting in the bench vice with the marked line just showing above the jaws, and saw across with a fine-toothed hacksaw, keeping the blade pressed down on the jaws. Mark the lugs on one side with a pop mark, so that the halves can always be put back the right way, then smooth off the sawmarks, open out the holes in the ring half with No 41 drill, and tap those in the other half either 3/32 in. or 7 BA.

Temporarily screw the halves together, chuck in the four-jaw with the hole running as truly as possible, face the side and bore out the hole to $\frac{7}{8}$ in. dia. a nice running fit on the eccentric tumbler on the driving axle. I always use a gauge—simply a stub of rod turned to the same size as the eccentric.

To face the other side I chuck the strap on the inside jaws of a little three-jaw kept specially for small work, but if it won't go on the smallest step of your ordinary three-jaw put the bit of rod used for a gauge in the chuck and clamp the strap on it by its own screws, putting a piece of paper between strap and rod to keep it tight. Then face off to an easy fit between the flanges of the tumbler. Don't forget the oil hole.

The 3/32 in. slot for the rod can be cut by running the strap, held in a machine vice on the lathe saddle, under a saw-type cutter on an arbor between lathe centres; or it may be just sawn and filed. The rod itself is made in the same way as the coupling rods, the little-end being bronze-bushed as shown, or case-hardened as preferred.

The larger end is thinned down to fit the groove in the strap and secured by two $\frac{1}{16}$ in. countersunk rivets. It may be soldered as well. The gudgeon pin or wrist pin is a piece of $\frac{1}{8}$ in. silver steel a full $\frac{9}{16}$ in. long turned down for $\frac{1}{8}$ in. at each end to 3/32 in. dia. and screwed 3/32 in. or 7 BA.

To erect the pump, replace the pump stay between frames and put the screws in. Put the strap on the eccentric and make sure that it works freely when the screws in the lugs are well tightened. Put the little-end in the slot in the ram, push the wrist pin through the lot and secure with commercial nuts. The pin should turn easily by finger pressure when the nuts are tight.

The gland should only be tight enough to prevent water leakage; over-tightening causes excessive wear of the eccentric strap. The pump for the $3\frac{1}{2}$ in. engine is of a different pattern, and all being well I will give details later.

● *To be continued*

GEAR CUTTING

Gear Wheels and Gear Cutting, by Alfred W. Marshall, explains the principles which govern the formation and numbers of the teeth for a given mechanism and describes the types of gears in general use.

There are numerous illustrations in this 92 page book, price 3s. 9d. post paid, which can be obtained from Percival Marshall and Co. Ltd, 19-20 Noel Street, London, W.1. Rate in U.S.A. and Canada is $1.00.

NOT SO NEW AS IT SEEMS

Did you know, asks J. N. MASKELYNE, they were talking about audible signals for railways in the 1870s?

JUST come into my possession is a copy of Sir John Wolfe Barry's textbook *Railway Appliances*, originally published in 1875 by Longmans, Green and Co.—though mine is a copy of the second edition, dated 1878.

In this book there is a diagram and description of what must have been one of the earliest attempts to evolve a system of audible railway signals. Moreover, my friend, Mr C. R. H. Simpson, who for several years until recently, was editor of *The Locomotive*, has unearthed an old photograph of a model built to demonstrate one of the methods whereby audible signals could be practicable.

Method of operation

After describing the ordinary fog signal, consisting of a detonator placed, either mechanically or by hand, on the top of a rail, and exploded by the wheel of a passing locomotive, the book goes on:

"Other means for giving audible signals have been proposed, and may be said to be on their trail. The best known are those which act on the whistle of the locomotive or on gongs on the locomotive, or in the guard's van. The method of their application is as follows:

At the place at which it is desired to give an audible signal to those in charge of the train, a rigid or elastic inclined plane is placed so that a pendent rod connected with the steam whistle or gong may be raised by it as the engine or van passes. The raising of the pendent rod opens the whistle or causes a weighted hammer to strike a gong, and thus attracts the attention of the engine-driver or guard. The inclined plane is made movable, so that when the semaphore arm is at "All right" the inclined plane is altogether removed, but when the semaphore is at "Danger" the inclined plane is placed so as to engage with the end of the pendent rod.

The same object has been attained by means of electricity, the making and breaking of contact being caused by much the same means as described. Of course, any such system requires that every engine not only of the company on whose line the audible signals are used, but also those of all companies working over the railway, should be furnished with the proper rods and levers to open the whistle or to strike the gong.

It is quite possible that a system of this sort may be found valuable as an adjunct to visible signals, but it is not probable that it will replace them, as they are simpler, less liable to derangement, and, except in thick weather, more efficient than audible signals."

The striking thing about all this is that the principle underlying our modern method of operating audible signals is precisely similar to that of the 1870s; only the methods are different. Did any railway actually instal audible signals prior to 1904? I doubt it.

The first installation I know of was on the Great Western Railway Henley branch in 1904, and extended to the whole of the main line during the next 40 years or so. A modified version is now being gradually applied to other main lines of British Railways, and there can be little doubt that during the next few years most of our main routes will be equipped with it.

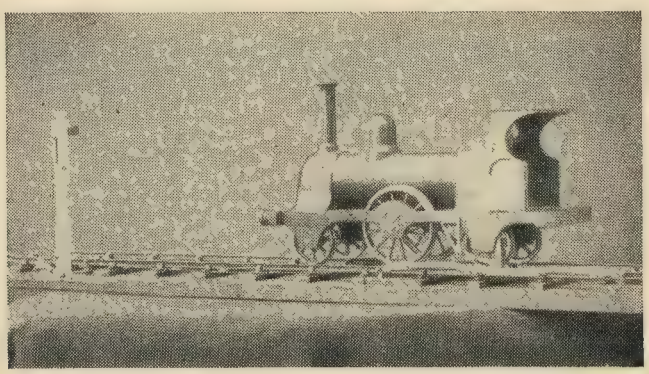
It seems strange that such an important step should have been so long in the taking. But there has existed a great deal of prejudice against it on the grounds that its use would tend to make drivers less vigilant on duty!

"Our little friend . . ."

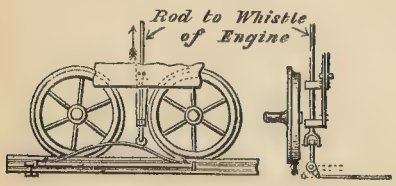
That was certainly not the experience of the old Great Western Railway, extending over more than 50 years. GWR drivers have always referred to it as "our little friend in the corner"; and they continue to treat it as such, relying on it to help them, when weather conditions make the sighting signals difficult, and not to do their work for them.

A study of the illustrations of the model shows that the 1875 apparatus, if it had been adopted, would have been at least positive and robust, in spite of—or perhaps because of—the lack of electrical aid. ▣

Right: Picture of the demonstration model of an audible signalling device



Below: Diagram of the working principle of the device



On the horns of a BRITANNIA

Not only does J. S. CURTIS confess his dilemma, but he does so in a spirit that can only be described as commendable!

HAVING embarked on LBSC's *Britannia* in 3½ in. gauge and being thrilled by the sight of the frames taking shape—to say nothing of the hours of blood and sweat liberated by the physical action of filing, drilling and chipping them—the time came to make and fit the peculiar-shaped hornblocks for the driving wheel axleboxes.

Now the design pundits of BR Standard engines may consider this rather unorthodox arrangement to be just the cat's whiskers. But I took a decidedly negative view of these horse-shoe-shaped slides.

I adopted these gadgets when I was feeling very brave, and I wanted my Junior *Britannia* to be up to the minute and to resemble her great, great grandmother, No 70000! Of course, the making of these horse-shoes was child's play by comparison with the fixing of them in the frame slots.

Next, I made up the little expanding units described by LBSC, which merely consist of a $\frac{3}{16}$ in. bolt and nut for holding these awkward things in position in the frames. One of the greatest difficulties connected with this job was in obtaining the correct projections of $\frac{1}{8}$ in. on either side of the frames.

The adjusting of these horns resolved into a long series of little taps on both sides, which slackened the expanding device, thus losing completely the near correctness of position I had obtained after considerable tappings and re-tappings. Eventually I had six horseshoe-shaped pieces of iron fixed in position, with a nice little $\frac{1}{8}$ in. projection just as the "words and music" told us.

Brazing, as all model engineers know, is a rather temperamental subject. Besides making one hot under the collar, it makes everything else hot except the thing that one desires most to get hot! However, the blow-lamps at my disposal were inadequate to heat up the mass of b.m.s. that *Britannia's* frames comprised.

I subsequently went into conference with a friend, and the result of this was that I was granted the freedom of the gas cooker. We decided ultimately that the grill and two gas rings, plus the use of a self-blowing gas torch, might raise sufficient therms from the nether regions to run a bit of brazing material around my "adjustments and patience."

One frame was duly set up in position over the gas rings and grill with the aid of bits of wood and pieces of metal. The heat was duly laid on, some flux mixed up and the brazing strip held at the ready. The grill, boiling rings and self blowing torch were all in full play on the leading axle hornblock for about half an hour, while my friend and I gradually discarded items of clothing, commensurate with the temperature of the inside of a furnace.

The brazing spelter was presented to the job with no outstanding formality, but no response was forthcoming; only a sickly, half-hearted, jammy sort of mess resulted. . . .

Summoning up courage, I began to cast around for a brazer of metals who would take on *Britannia's* horse-shoes. The only likely man was Brother Spelter, who lived in a town about 12 miles from my workshop. He thought the job would be quite straightforward. But when I presented myself in due course his attitude towards me had altered considerably. He asked me what the frames were made of, as he had had a dickens of a job to get the horseshoes brazed to the frames.

That made three frustrated brazers in all . . . I was a few hundred therms short and Brother Spelter was about three cylinders of acetylene down. So my gas cooker effort was not so comic after all.

Unfortunately, two of the horns were welded in out of adjustment and there was nothing for it but to rip them off. The next problem was how to remedy the defect; how to replace the two torn-off horseshoes, and what with. One thing was certain, there would be no brazing.

The missing horns were replaced by eight pieces of $\frac{1}{8}$ in. mild steel plate. Four of these plates were screwed and riveted on either side of the axlebox opening in the frames, and the axlebox fitted so that it moved easily up and down over the plates—having little or no fore and aft play. This was a tedious job, but I found it easier than brazing horse-shoes. And I am glad to say that despite the fact that *Britannia* has two false ribs in her anatomy, she is none the worse for it.

This is probably a typical instance in the process of building small locomotives by enthusiasts with limited skill and equipment. Nevertheless the fascination and interest that automatically arise when jobs like this crop up never wane.

There is always the distant view of a finished product to look forward to—a small working locomotive made from the product of ingenuity and enthusiasm, and wrestled from lathes not quite big enough, from vices not quite hefty enough, from tools not quite what they should be. But this is life to the Ferroequinologist.

A Ferroequinologist, gentlemen, is a student of the iron horse. ▣

A three-speed gramophone deck

QUALITY is not achieved without cost, says Wellings W. Whiffen, introducing to readers of *Home Mechanics* his three-speed gramophone deck. In fact, you can buy one of the cheaper models for the cost of the component parts of this one. But this is a quality machine.

The construction demands a fair degree of engineering skill and should for this reason appeal to model engineers. The machine is capable of fine adjustment for exact speeds. This adjustment, depending on precision-tapered capstans, is one of the many well-designed features of the playing deck.

Readers who examine the drawings and instructions will see that the author not only knows his stuff where electrical equipment is concerned but he has a considerable grasp of the mechanical problems involved in transferring his designs from the board to the bench. He is aware, for instance, that no amount of electrical refinement can cure vibration if the fault lies in a hole out of true or a cam mounted slightly eccentrically.

Full details of the three-speed gramophone, with working drawings are carried in the July issue of *Home Mechanics*, now on sale at all bookstalls, price 1s. 3d. or 1s. 6d. from the publishers, Percival Marshall, 19-20 Noel Street, London, W.1. The issue also has articles on how to build a caravan, a directional clothes line, a blanket chest and how to service the Bond minicar. ▣

5 in. gauge diesel electric loco

A. E. MASON writes about his freelance 1-B-1 which, after five years' work, is now nearing completion

My locomotive is the result of quite a lot of experimental work and was first built as 0-B-0 for use as a battery electric locomotive. It was found, however, that more than 12 v. was required to give a decent speed and, as no more than two 6 v. car batteries could be carried, the job was left alone for a time.

After a while the idea of making the job into a petrol electric gradually took shape and I decided to make the attempt.

Second-hand Power Pak

For the engine or prime mover I made up a 50 c.c. unit, using a second-hand Power Pak cylinder, which I rebored. (I bought a new oversize piston complete.) The crankcase in halves is cast in iron from my own pattern, and with Edgar T. Westbury's carburettor from drawings and castings supplied by ME advertisers it makes a neat little unit.

The generator is a 12 v., 4-pole car dynamo obtained from a local second-hand spares dealer. This was found by experiment to give enough output at 1,500 r.p.m. and so is coupled to the engine by 1-2 ratio motorcycle timing gears. And when dynamo was tried out direct-coupled to the engine it was the master and stalled the engine if put on full load.

The traction motor is an ex-aircraft motor which I had in store for some time. It had a 6-pole field which I re-wound with 16 s.w.g. wire to make a series machine.

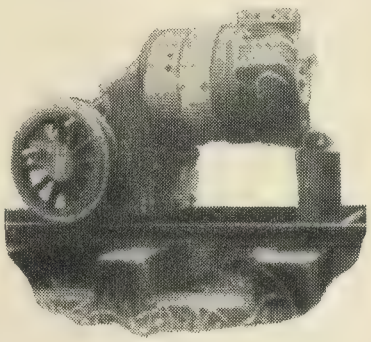
How exactly this motor behaved in this form I knew, of course, from my experiments with the chassis as a battery job. This also applied to the motor-gear ratio to the wheels. This was first 8.4 to 1 with the jackshaft and a large spur wheel showing on the outside of the frame, which I did not like.

In its present form the gear ratio is 6.3 to 1, first reduction spur gearing and second reduction bevel gears with the front end of the motor pivoted and the rear end bolted to the gearcase carried on the driving axle. All the gears are enclosed and run in oil, including the engine drive to the generator. I have also made new frames and lengthened the locomotive, adding a pony truck at the front and rear.

The third brush has been removed from the dynamo, and the shunt field connected across the armature brushes, with a variable resistance to keep the field current to within 1 to 3 amp at the maximum locomotive speed.

The cab controls are the carburettor control lever, drum-type reversing switch; and the field resistance control handle. Other cab fittings include the voltmeter, 0-30 v. across the generator terminals; ammeter 0-20 amp for the main current, and another 0-6 amp for the field current.

The bench tests gave satisfactory results and I have recently had a run or two on my own garden track and the local club track.



Above: Motor and gears on the driving axle. Below: The loco chassis

Up to the present time I have not had much experience of driving, but properly handled there is no doubt that this type of i.c.-engined locomotive will give very smooth and sweet control.

The method of driving is to rev. up engine and, at the same time, to cut out the field resistance. Then, when the engine and train are under way, the field resistance is cut in again as required by running conditions.

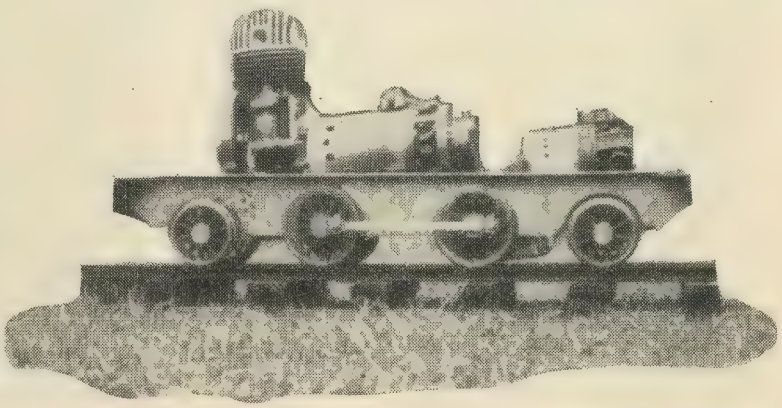
No test of the hauling capacity has yet been made, but on the local club track two adults were hauled at a fair speed. The radii of curves on this track are 30-40 ft, and a drawbar pull test on a straight portion of the track gave a pull of 22 lb.

Of course, the standard of efficiency of this locomotive is poor, but then all small-power units function at a disadvantage, including small steam locomotives.

The petrol engine on this locomotive is rated at $\frac{1}{2}$ h.p. and I know from earlier tests that the dynamo efficiency is round about 50 per cent. Motor efficiency is not known, but may be a bit better than this.

During recent running I have noticed readings of 20 v. with 10 amp, and this seems to be the maximum output so far, which suggests a total efficiency of 25 per cent, i.e. perhaps $\frac{1}{8}$ h.p. at the drawbar.

In conclusion, I would say that a diesel electric locomotive is decidedly more interesting than a straight i.c. job and, in some ways, has an appeal above that of the steam locomotive. ■



A CENTRE FINDER

As an aid to precision work this tool is invaluable. J. NIXON supplies full constructional details

THERE are many lathe operations which need to be initiated by truing the workpiece mounted in the chuck or on the faceplate, the reference mark more often than not being a light punch dot; on the accuracy with which this mark is centred the precision of all subsequent operations may depend. Of course, if accuracy is not of prime importance it suffices to use the dead centre as a reference point.

However, sooner or later, the precision job presents itself and it becomes necessary to employ methods which will ensure a finer degree of accuracy. If the work already has a concentric turned surface a dial test indicator is the ideal instrument to use, but not everybody can afford this luxury. However, there is no earthly reason why the owner of the most modest of workshops should not possess a centre finder, familiarly known as the "wobbler."

The cost can be measured in pence and a few hours of pleasurable work. In its essentials nothing could be simpler mechanically, and for those who have never got round to making one, perhaps the drawings which accompany these notes may provide that incentive.

Although this tool is simple in principle, it should possess certain essential features, and one in particular, that of flexibility, seems to have been overlooked in some of the designs which I have seen. Therefore, although there is no world-shattering novelty in the design submitted, it does combine great flexibility with accuracy in its application; once it is set up adjustments to the workpiece can be made without repeated adjustments to the wobbler itself.

The pointer is a standard length of silver steel and the full 12 in. or 13 in. of it may be used if desired, as the arm ratios are not of vital importance; the figures given in Fig. 1—a ratio of 6 to 1—ensure a fair degree of accuracy in application. The points at either end should be hardened and tempered down to a deep straw.

TRUNNION BLOCK

For the simple reason that square section material lends itself more kindly to accurate cross drilling, the pointer trunnion block (Fig. 1) is made from ¼ in. square silver steel. Drill a hole No 56 through one side and, with a BSI Slocomb centre drill and countersink the holes at either side until the top of the countersink is 3/32 in. dia.

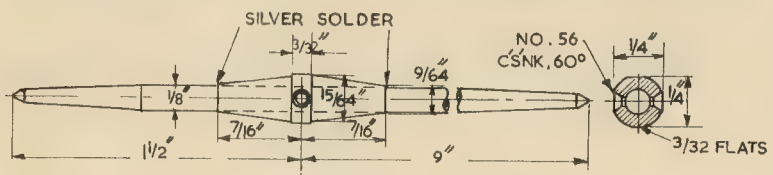


FIG. 1
The trunnion block and pointer

Set up the stock in the independent chuck and centre it very carefully; as you don't possess a wobbler this can be done by setting to the tool until all four corners just touch. After drilling the ⅛ in. hole for the pointer along the stock, turn the corners off until the turned surface just touches the edges of the countersink. Next turn the tapered ends, again until the edges of the countersink are just touched; the second tapered end will part off the piece. The pointer is sweated, or, better still, silver soldered into the trunnion block.

THE GIMBAL

For the reason given in the case of the trunnion the gimbal should also be started by selecting a length of ½ in. square mild steel stock. Drill cross-holes right through two adjacent faces; one, again with a No 56 followed by a BSI countersink, the other with a No 43 which is tapped 6 BA. After boring and turning to dimensions (Fig. 2) not forgetting the large radius at the mouth of the bore which permits maximum latitude to the pointer, the piece is parted off or sawn from the stock; all that remains is to repeat the radius at the parted face.

This piece should finish with four 3/16 in. square faces on the periphery.

GIMBAL FORK AND SPRING

A cross-hole, 6 BA tapping (No 43), is drilled through the narrow face of the stock before cutting the gab; you may have to tap it from both ends of the hole as an ordinary 6 BA will hardly have the reach to do this operation from one end. The flat spring does not require an unusual amount of resilience or latitude, as a very small deflection will keep the pointer firmly in place as the job is turned slowly for setting. Failing spring steel for this part, an old kitchen knife can be made to serve well enough (see Fig. 3).

THE PIVOTS

The pivots should be made from silver steel and, if you so desire, you can harden and temper them. However, if the pivot bearings are filled with light grease on assembly, the

The gimbal ring and pivots

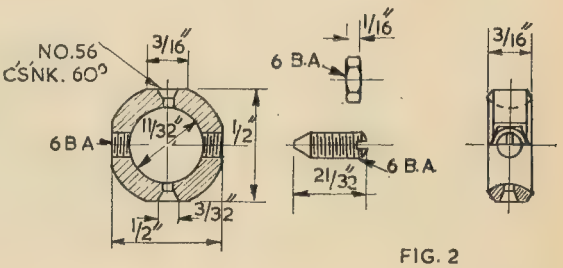


FIG. 2

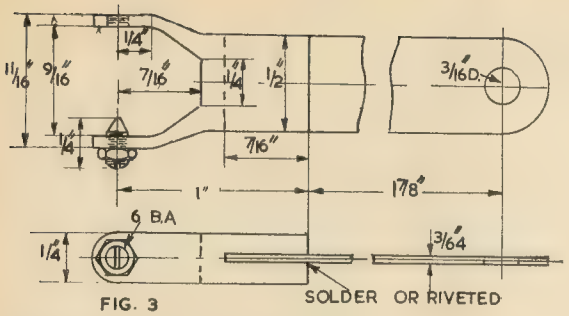
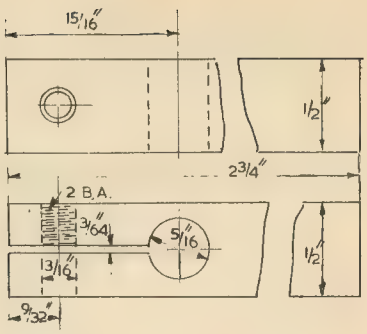


FIG. 3

Left: The gimbal fork and spring



Right: The stock and clamp bolt

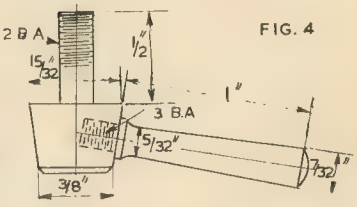


FIG. 4

chances are that you will be able to hand down the wobbler to your grandson as a going concern !

THE STOCK

The spring (Fig. 4) is made a working fit in the slot in the stock, which is mounted in the tool post; vertical alignment of the pointer is attained by manipulation of the clamping bolt.

Although this fitting can be most useful under certain circumstances, I have a rooted objection to dismounting a carefully-adjusted turning tool except for sharpening purposes; therefore, in order to avoid this I prefer for general use an alternative method of mounting, which, incidentally, I use for the dial test indicator—when the use of this particular instrument is indicated.

MOUNTING BASE

This contrivance (Fig. 5) strongly resembles a surface gauge except that, with its solid, wide base it is much less liable to slip off the shears or tip over if accidentally touched as a surface gauge is so liable to do; being free, too, it can be moved out of the way quickly when no longer required.

The foundation of the thing will be readily recognised as an old cast-iron flat iron. If you haven't one of these defunct domestic appliances lurking in some obscure corner of the house there is no doubt that the nearest second-hand dealer will be happy to sell you one very cheaply.

First, saw off the handle. The bottom face will be smooth, of course, but not necessarily flat; therefore it should be machined so that it will stand on the shears of the lathe without rock in any position. The top face is also machined to take two slide bars, milled or planed to the section shown.

The fittings are wholly conventional, and detail drawings of them are included only to present a complete picture of the rig (Fig. 6). ■

The base, pillar and T-head and pillar mountings

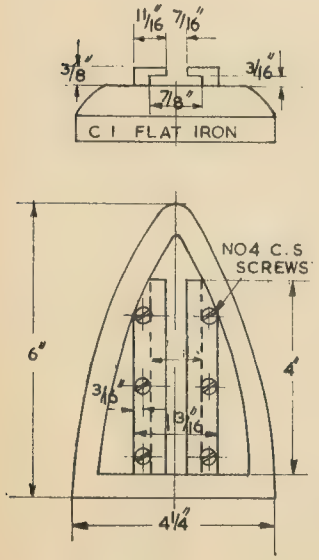


FIG. 5

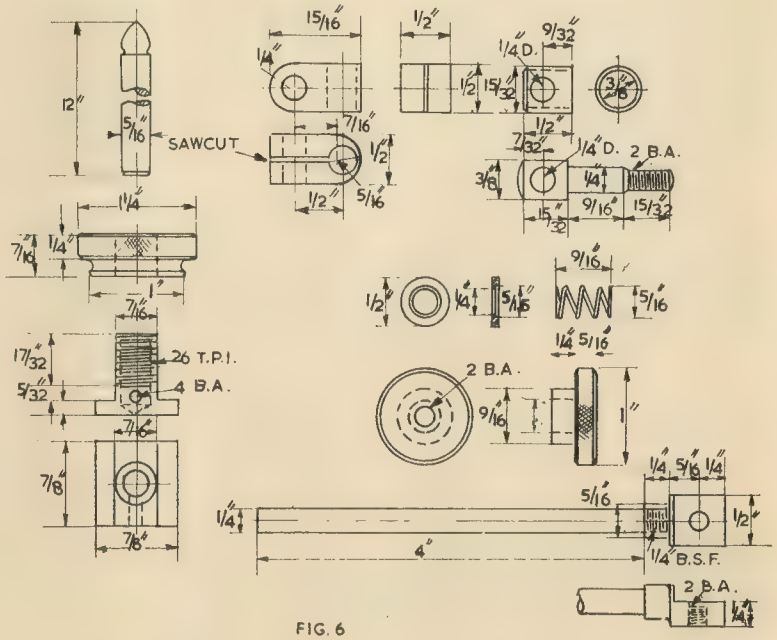


FIG. 6

By DUPLEX

A CUTTING-OIL FEED FOR THE LATHE

THE AIR COMPRESSOR

ALTHOUGH there are several ways of machining the overhung crankpin of a one-piece crankshaft, the following method ensures that the work is rigidly mounted, and in the past it has always given satisfactory results when used in the workshop.

For this purpose a jig of the type illustrated in Fig. 7 is bolted to the lathe faceplate at the required eccentric setting, which is equal to the throw of the crank. The turned portion of the crankshaft is then secured in the machined bore of the jig by means of a pair of hexagon-headed setscrews which are firmly tightened to press on brass pads.

To save material and to reduce the overall dimensions the jig has purposely been made with only a single bolting lug, but this will afford a secure fixing if two $\frac{3}{8}$ in. dia. bolts are used for attaching the jig to the faceplate. The jig illustrated is designed for mounting on the 9 in. dia. faceplate of the Drummond lathe, but the spacing of the bolt holes may have to be varied to suit the faceplates of other lathes.

Although for all mechanical appliances requiring rigidity castings are much to be preferred, a jig of this kind can be built up quite easily by using as a baseplate a piece of $\frac{3}{8}$ in. mild steel, 2 in. in width and some 6 in. long, with a hole drilled at either end for bolting to the lathe faceplate.

To this plate is attached a cast-iron or mild-steel block, and the assembly is then secured to the faceplate for machining the bore to fit the parallel portion of the crankshaft. If this bore is made greater than $\frac{3}{8}$ in. in diameter, larger crankshafts can be mounted in the jig by inserting an accurately-machined split collet.

In some instances, where the throw of the crank is small, it may be found possible to obtain the correct eccentric setting by mounting the work in the four-jaw independent chuck or, again, an eccentric bush may be machined and slit so that the shaft can be held when the bush is gripped in the self-centring chuck.

The prototype, one-piece crankshaft is illustrated in Fig. 8, which also shows the outer bearing bush that forms an adjustable packing gland to serve as an oil seal for the journal. An alternative method of making the crankshaft is to adopt the built-up form of construction shown in Fig. 9.

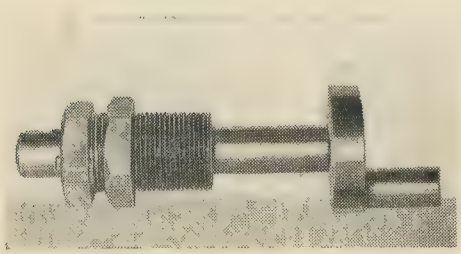
When mounted between centres the shaft is first turned parallel and then shouldered and screwcut so that it is accurately located in the crank disc. The $\frac{5}{16}$ in. dia. crankpin is also machined in the same way before being screwed firmly home in the crank disc.

For the light work required of the compressor this form of construction will be found quite satisfactory, provided that the direction of the drive is arranged to tighten the threaded components more tightly together. To give additional security the crankpin can be locked in place by fitting an Allen grubscrew to the crank disc at a point where there is an ample thickness of metal.

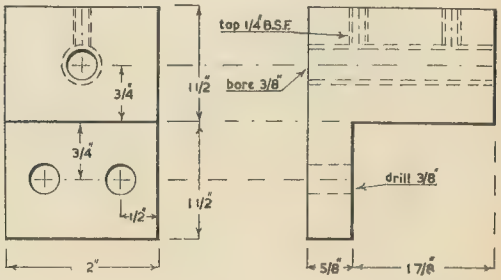
For obtaining the best working conditions and ensuring freedom from wear both the crankshaft bearing bushes and the crankshaft itself, as well as the crankpin, should be lapped to a high surface finish. Since in the prototype the latter parts are left unhardened, this process can be omitted in the present instance; this will avoid the risk of distortion and will ease the work of lapping. External laps for this purpose are made as required in the workshop from cast-iron ground rod of the kind used for making valve guides and other engine parts.

The laps are finish-bored to a close fit on the work and, after being slit through on one side and partly through on the other, they are mounted in a ring holder with two long 2 BA screws to compress the lap and serve as handles. The small central screw shown fitted to the lap holder illustrated in Fig. 10 engages in a dimple formed in the lap and enables the lap to be expanded for dealing with oversize work. When, after an adjustment has been made, all three screws are tightened the lap is securely gripped and the bore is accurately held to size.

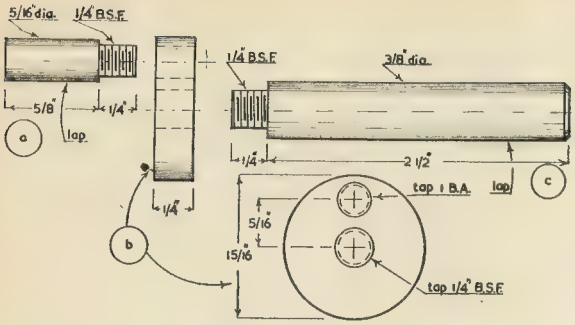
After any lapping operation it is essential to remove all traces of abrasive by repeated cleaning with paraffin. The parts should be assembled and run under light load for a short time before being dismantled to repeat the cleaning process and lubricate afresh. This procedure should if necessary be continued until the bearing oil remains clean after the parts have been put into service. The presence of blackened oil is a danger signal indicating that bearing wear is taking place.



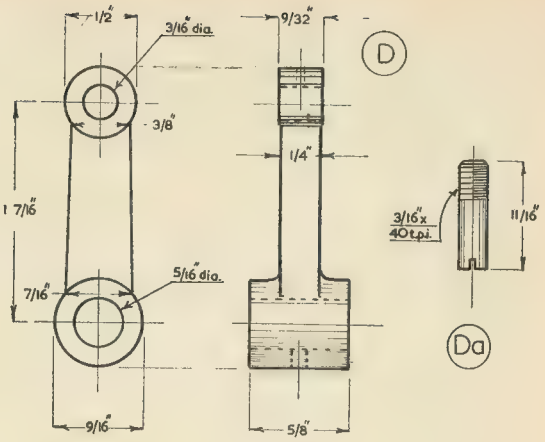
Left, Fig. 8 : The crankshaft and bearing bush with packing gland of the prototype compressor



Right, Fig. 7 : A faceplate jig for machining the crankpin



Above, Fig. 9: *The built-up crankshaft. The crankpin* a; *the crank disc* b; *the shaft* c



Right, Fig. 11: *The connecting rod* d *and the gudgeon pin* da

THE CONNECTING ROD

The connecting rod *D* fitted to the prototype compressor is a bronze casting with plain, unbushed bearings; but, again, some workers have found that a duralumin rod gives good service even when both the big-end and little-end are not fitted with bushes.

Where a casting is not used, a bronze rod can readily be built up by silver soldering the big-end and little-end bosses to the shaft. Alternatively, the rod can be either fabricated or machined from mild-steel bar and the bearings afterwards fitted with phosphor-bronze bushes.

By adopting a built-up rod with a shank made from $\frac{1}{4}$ in. × $\frac{1}{2}$ in. mild-steel bar, the work can be readily mounted on the lathe faceplate for boring the two bearings in accurate alignment.

As splash lubrication is relied on for the connecting rod bearings, oil passages are drilled at the upper end of the little-end and at the lower end of the big-end; but, to take advantage of the oil running down the shaft of the rod, additional oil ducts should be drilled on either side of the rod at the junction between the shaft and the big-end boss.

In the prototype compressor the big-end of the connecting rod is heart-shaped, because at the bottom of its travel it strikes a spring-loaded piston and forces a jet of oil to impinge on the connecting rod; but in the present instance splash lubrication is relied on and the connecting rod is of orthodox shape.

THE CYLINDER

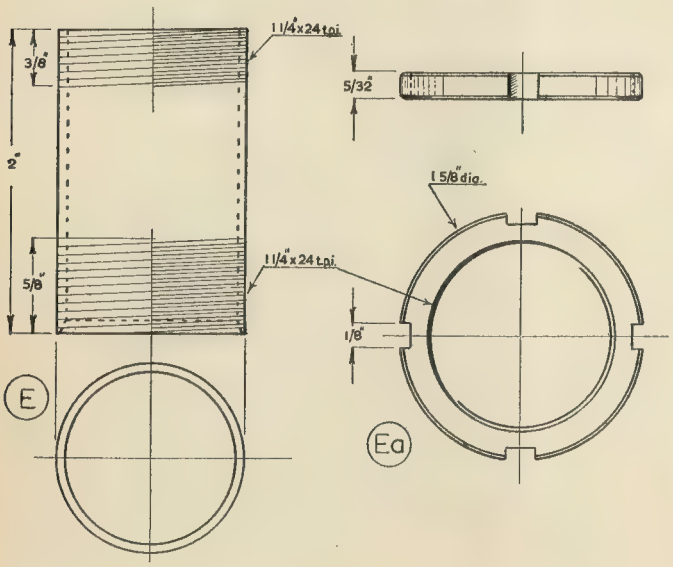
The cylinder barrel is a separate part which is screwed into the cylinder head and sweated in place; at its lower end the barrel is also threaded and in the prototype it is secured in the crankcase by means of a pinch-bolt, but in the modified compressor a locking ring is used for this purpose.

Brass tubing is used for making the barrel which is best mounted on a mandrel for screwcutting the two ends. Tubing of 16-gauge is suitable for a barrel of $1\frac{1}{4}$ in. outside dia. and approximately $1\frac{1}{8}$ in. bore. If the tube is gripped in the four-jaw chuck, there will be a danger of deforming the material unless a well-fitting metal plug is lightly pressed into the bore and, even then, care will have to be taken to avoid damaging the finished threads.

As will be described later, the piston is fitted with a leather cup washer to form an air seal during the compression stroke; consequently, the cylinder bore need not be precisely circular or parallel, but to avoid unnecessary friction and wear it should be brought to a polished finish.

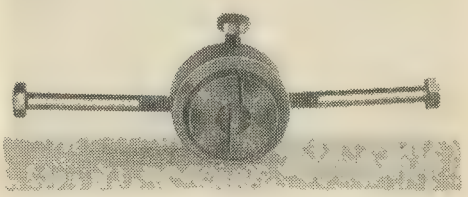
For this purpose, a turned hardwood lap will serve quite well when charged first with fine emery powder and finally with liquid metal polish. To take up wear the lap should be split so that it can be expanded with a wedge in the same way as a hammer head is secured to a wooden shaft.

● *To be continued*



Left, Fig. 12: *The cylinder barrel* e; *and the barrel locking ring* ea

Below, Fig. 10: *A simple form of adjustable external lap*



READERS' QUERIES

Do not forget the query coupon on the last page of this issue

This free advice service is open to all readers. Queries must be on subjects within the scope of this journal. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling, cannot be given: stamped addressed envelope and query coupon with each query. Mark envelope "Query," Model Engineer, 19-20 Noel Street, London, W.1.

On patenting

I have recently completed working on a device which I consider to be worth patenting and I would appreciate your advice on how to do this. I would also like to have some details of patent agents' fees.—MJS, Bristol.

▲ *You are strongly advised to get in touch with a chartered patent agent and obtain his assistance in this matter. It is possible to carry out the necessary work in preparing specifications by yourself, but it should be remembered that a patent specification is a legal document and, unless drawn up by a person with both legal and technical knowledge, may be practically valueless from the legal point of view.*

Full details of patent agents' fees and the total cost of taking out patents can be obtained either direct from the Patent Office, Southampton Buildings, Chancery Lane, London, WC2, or from the patent agent.

Indexing gear train

I am constructing a leadscrew index for my Myford ML2 and I wish to mark off 125 divisions. Would you let me have the necessary gear train to do this? I have the full set of change wheels, i.e., 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, and I can obtain the extra gears if more than one of any size is required.—JWF, Godalming, Surrey.

▲ *The marking off of 125 divisions for a leadscrew index cannot readily be obtained with the wheels specified. If, however, you obtain an extra 50-t wheel you could then use a double-compound train using the following wheels:*

$$\frac{50\ (mandrel) \times 50 \times 60}{30 \times 20} = 125$$

By arranging a detent and counting one tooth at a time this will give 125 divisions.

However, although compound wheel trains are often recommended for divisions of this nature, they are in many cases liable to produce errors due to the difficulty in eliminating backlash. Therefore, it would be far more satisfactory to arrange a worm to mesh with the wheel on leadscrew, in which case a 50-t wheel could be used on the leadscrew, and any wheel having a multiple of five teeth could then be used on the wormshaft. For instance, a 30-t wheel would be advanced six teeth at a time to give 5 ×25 = 125 divisions.

The great advantage of worm-dividing gear is that it allows backlash to be completely eliminated and also reduces the error on the final indexing in proportion to the degree of worm reduction.

Rocket model

I wish to make a small-scale model of the *Rocket* engine. Can you tell me where I could obtain suitable drawings?—PM, Darlington.

▲ *Drawings of the* ROCKET *are preserved in the Science Museum at South Kensington, and you may be able to obtain photostat copies if you write to the director and secretary of the museum. These drawings were reproduced in the book A Century of Locomotive Building by J. G. H. Warren, and it is possible that you may be able to find a copy in the municipal library in Durham.*

The drawings are not very complete because in those days it was not the practice usually to prepare full general arrangement drawings of locomotives or other engineering products.

Atom V oil pump

I have received your drawings for the *Atom V* engine, but cannot find any reference to the construction of the oil pump—nor is it listed separately. Can you assist me, please?—JBS, London, N.7.

▲ *Details of this oil pump are not shown on the engine drawings as it had been fully described in* MODEL ENGINEER *before the issue of the* ATOM V *design. It is also to be found in the Percival Marshall handbook Model Petrol Engines, chapter* 10, *Figs* 61 *and* 62.

Most of the constructors of the ATOM V *engine have preferred to use the more common system of petroil lubrication, though there are advantages in arranging a positive supply of oil by means of the metering pump.*

The 18-pounder gun

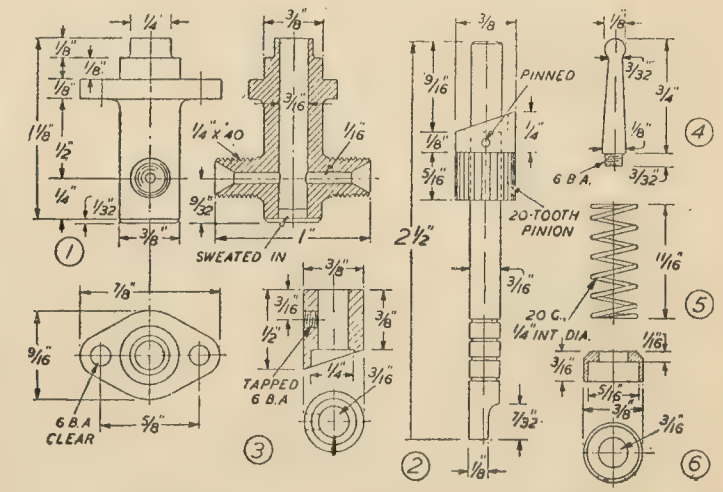
As I wish to make a model of the 18-pounder gun recently described in ME, I should be grateful if you can enlighten me on the following points:

1 How does the carriage body traverse, as it seems locked to the axle passing through its bearings.

2 Is the elevating screw rod fastened to the rocking-bar sight for the purpose of elevating the gun.

3 How are the brakes locked on to the wheels.

4 What is the purpose of the third hand wheel on the other side of the breech.—AEW, Bromley, Kent.



Above and right: Details of the ATOM V *oil metering pump*

▲ 1 *The carriage is traversed by the rear l.h. hand wheel. This is mounted at the end of a screwed cross-shaft which engages in a tubular nut inside a steel housing. The r.h. end of the nut is formed into an eye, and swivels in a fork joint on a bracket fixed at the end of one of the triangular side brackets. The housing itself is silver soldered to a ring riveted to the trail.*

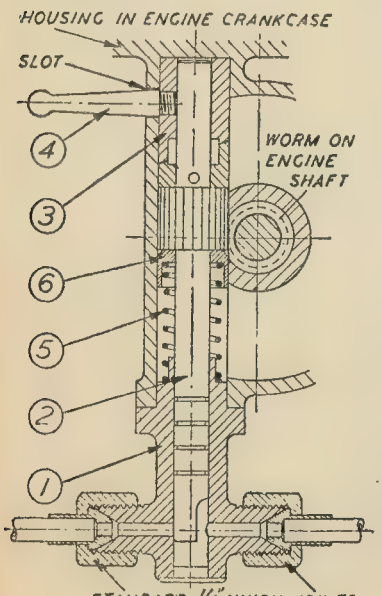
2 *The elevating screw rod, the base of which is linked to the elevating screw, is connected to the underside of the rocking-bar sight. Consequently, by turning the screw the sight is raised or lowered. The hand wheel is a dummy, owing to the impossibility of fitting mitre or bevel gears in the small space available, so the lower end of the screw is slotted for a small screwdriver.*

3 *The rear end of the brake rods, which incline inwards towards the centre of the shield, are tapped. They engage with small screwed eyes fitted on the underside of the brake blocks. The r.h. rod protrudes in front of the shield, and is fitted with a crank handle.*

4 *The hand wheel on the r.h. side of the breech is another dummy. On the prototype it also operates the range-gear drum adjacent to it, but again, in a small model it is not possible to arrange for it to work because of the lack of room.*

Metal weights

Can you give me the respective weights of gold, lead and mercury, and recommend a book containing information on atomic weights, specific gravity and the main characteristics of these metals?—PWR, Nelson, New Zealand.



▲ *The respective weights of gold, lead and mercury are as follows:*

Gold:	0.69 *lb. per cu. in.*
	Specific gravity 19.32
	Atomic weight 197.2
Lead:	0.41 *lb. per cu. in.*
	Specific gravity 11.37
	Atomic weight 207.21
Mercury:	0.49 *lb. per cu. in.*
	Specific gravity 13.56
	Atomic weight 200.61

Atomic weight refers to the basic structure of an element and does not necessarily bear direct proportion to the physical or mass weight.

Specific gravity is a figure based on the weight per volume of water, which is represented as 1. *Thus, a substance having a specific gravity of* 2.5 *would be two and a half times as heavy as water.*

Information on these and other physical factors of metals and alloys can be found in most standard text books on metallurgy and also in some of the popular engineering pocket books or similar reference works, such as Kempes Engineers' Year Book.

Flash steam

I wish to carry out an experiment with flash steam. The maximum input water pressure would not exceed 60 p.s.i. and the resultant steam will pass through an orifice approximately equal to a No 70 drilled hole. The source of heat will be oil, but not by the use of a blow lamp-type of burner. Specifically, would a heavy-gauge brass tube be suitable for the boiler?

I have in mind using an inside diameter of $\frac{1}{4}$ in. or $\frac{3}{8}$ in. Super heat is not necessary, so the tubing would not be subject to extreme temperatures; the necessary area of tubing could be fairly large so as to keep the final tube-heat to a reasonable value. I know that the vaporising coils of a blowlamp having brass tube, runs at a good red heat when in operation, and I am basing my idea of the brass tube on this but would first like to be sure as to the most suitable metal to use for this boiler.—JWC, Enfield, Middx.

▲ *Brass tube would be quite suitable for the construction of the boiler provided that the temperature is not excessive. It would, in fact, be better than copper as it is not so liable to internal scaling.*

If, however, you could obtain a copper alloy, such as tungum, or one of the high-temperature nickel alloys this would have superior heat-resisting properties. But as you are not proposing to use superheat, this may not be of great importance though you will no doubt appreciate the necessity of keeping water flowing through the tube the whole time the burner is in operation.

BROWSING AMONG THE P.M. BOOKS

For some of us no smell brings back a day in childhood more vividly than the reek from a smoking, oily traction engine, a distinctive mixture of the acrid and the bland.

W. J. Hughes is a modeller who loves that smell—even when it is blended, for good measure, with the tarriness of road mending. I can almost catch a whiff of it as I turn the amply-illustrated pages of his *Traction Engines Worth Modelling* (Percival Marshall, 12s. 6d.).

In these pages Mr Hughes, the begetter of the famous ME Allchin, is a model engineer writing for model engineers, but he also knows that no model traction engine exists in a void. The modeller wants to know as much as he can about the originals—not only how it worked but also when and where it was built and what happened to it. Perhaps no type of model except the ship model needs its natural background quite so much as a model road locomotive. Frequently that background is very local, a fact which does not detract from its interest but invests it with still greater charm.

After giving us the clearest description that I know of the general features possessed by the old engines, Mr Hughes deals in succeeding chapters with the gearing, wheels, brakes, pumps and other essential details. Then he turns from the full-size engine to the construction of a model.

Six of his chapters are devoted to particular engines for which (as the book explains) blueprints are obtainable. They are the Marshall 7-n.h.p. general purpose engine, the Allchin 7-n.h.p. No 3251 *Royal Chester*, the Marshall compound five-ton tractor, the Aveling and Porter compound steam roller, the Fowler B.6 *Big Lion* road locomotive, and Ransome and May's *Farmer's Engine* of 1849.

The *Farmer's Engine* was a pioneer designed by Robert Willis, built by E. B. Wilson and Company of the Railway Foundry at Leeds. Had it not been for the care taken by other men in other days, all trace of this mechanical masterpiece would have been lost—a warning to us in 1957 and also, more happily, a reminder of what the steam engine lovers of the world owe to the devoted hard work of men like Mr Hughes, the historians and the modellers whose enthusiasm is bringing these fragments of the past together before they are utterly forgotten in the flow of time.—J.M.

POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

TRACTION ENGINES

SIR,—With reference to the recent remarks about Burrell engines made by C. Page in his article and G. K. King in his letter, I feel sure you will allow me to state that the matters raised therein have all been fully covered and explained in my *Chronicles of a Country Works* published by Percival Marshall and Co. Ltd.

The Foden rear axle springing I have also illustrated and dealt with in MODEL ENGINEER for 4 August 1949.

Norwich. RONALD H. CLARK.

THE "FIXIE" VICE

SIR,—I was interested in LBSC's reference [May 23] to the "Fixie" vice, for while I have in a sense been familiar with this item for years, due to its being listed in a well-known tool merchant's catalogue, it seems to be a very rare bird in the flesh.

I had never actually seen one until last year; this was at the Machine Tool Exhibition held at Olympia in June, where it was shown on the stand of Frank Guylee and Sons, Archer Tool Works, Sheffield, 8.

According to a leaflet obtained at the time it is at present made in five sizes, from 3 in. to 8 in. width of square jaw, ranging in price from £10 10s. to £42, and in weight from 22 to 198 lb. Unfortunately the smallest size, and probably the only one the average model engineers' lathe would swing, has a 1½ in. width of jaw, weighs 3 lb., and appears to be out of production; whether temporarily or not I do not know.

I think LBSC is in error in saying this vice is of American make as I believe the makers and originators are a Birmingham firm, J. H. Jerrim and Company. A small point but one of consequence to any would-be purchasers in view of the current difficulty or even impossibility in purchasing American tools and equipment.

Hanwell, W.7. F. SEWARD.

LONE WOLF

SIR,—I want to express my admiration for your wonderful magazine. I began to take it last year, though I have known it for more than a year.

I am sending some pictures I took of the latest scale model I am working on—*HMS Bounty*. Although I have made several models for years, I have no contact with other modellers, I am what you call a "lone wolf."

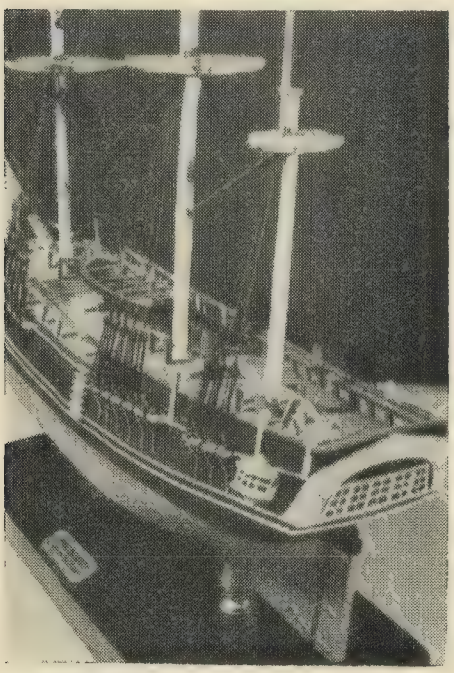
Argentina. JULIO M. FOURET.

OIL CO's STEAMERS

SIR,—I was very pleased to see you printed my letter about undertype and overtype engine chimneys, but I fear an error has crept in. I was not referring to the flywheel but to the baseplate when I suggested it might be a single casting.

I believe J. Samuel White built some Magdalena river steamers; I seem to remember two coming from them about 1927-28. They were *Troco* and *Carare*, they were oil fired and among the most powerful. Their function was to transport oilfield staff and do heavy towing (really pushing) for the old Tropical Oil Company, now part of Esso, in South America. They carried thousands of tons of pipeline material and finished petroleum products up the river at the proper seasons.

London, N.W.7. H. H. NICHOLLS.



ARGENTINE MODEL OF HMS BOUNTY

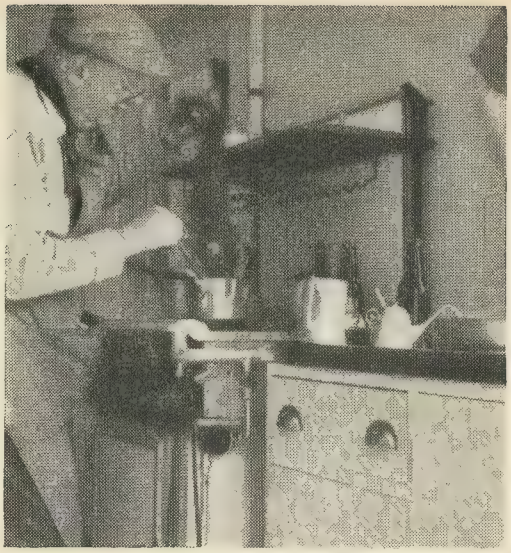
Deck view (left) looking forward. Mizen mast has no shrouds on starboard side, and guns and wheel are not in place. Right: Deck view, looking aft. See Julio M. Fouret's letter

A PERSONALITY!

SIR,—As one of your correspondents would like to see some personality pictures in our journal, I venture to send you the enclosed picture of myself with some celerity, hoping that it will fill a gap while your official photographer hunts the greater celebrities.

The only claim I have to be an august personage is that annually in August, at the Grand Regatta, I am to be found partly submerged in the waters of Victoria Park.

Surrey. R. O. PORTER.



Mr Porter sends the amusing picture (right) which he captions: "Retired dressmaker's labourer, no pension"

RAW MATERIALS

SIR,—Martin Cleeve, in his recent articles on making a boring toolholder, states that he does not know why it is that some readers have expressed difficulty in obtaining larger sections of mild steel. I must say, in support of those readers, that authors who often have easy access to raw materials overlook that other workers may not.

I make my own lathe accessories and workshop tools whenever possible and find the methods of Martin Cleeve and Duplex, using mild-steel sections, most convenient. I do find, however, that obtaining raw materials at a reasonable cost, is not easy.

There was one advertiser in MODEL ENGINEER who supplied a wide range of the larger mild-steel sections in small quantities and at reasonable charges. Unfortunately this supplier has recently closed his business. Other advertisers supply only a limited range of sizes and, from my own experience, they will not supply other sizes than those listed by them. I recently ordered some 1 in. × $\frac{3}{16}$ in. b.m.s. angle from one of the well known advertisers. The answer I got was: "Sorry, this has been discontinued."

Non-ferrous metals of all sizes are more easily obtainable because certain large firms are prepared to supply small quantities, but in those cases the price is out of all proportion to the value of the material and is often more than the price of the factory-produced finished article one wishes to make.

I should add that although I live in an industrial area, supplies for model and experimental engineers is practically non-existent.

Newcastle upon Tyne. T. W. PARKIN.

SIR,—I have been waiting three weeks for a price list from a reputable firm. I have sent the required cost and postage but still no news. What is the matter with them? The order I proposed to make would have run into double figures, which, I may say, they have now lost to another firm. I sent an order (nothing to do with the above) to K. A. Whiston on May 14 at mid-day; I received the goods in two parcels, about 14 lb. on May 17. Good luck to Mr Whiston.

Sussex. H. PARKES.

SIR,—I have twice had trouble with unsatisfactory castings. Bogie wheel castings for *Maid of Kent* were returned twice to the supplier before suitable castings were received. On this occasion, also, the drivers were the wrong shape and had to be corrected by hours of laborious filing. Some of the valve-chest parts were unusable and I finally fabricated them from heavy bar stock.

More recently, in a set of castings for *Titfield Thunderbolt*, from a different but extremely reputable advertiser, the valve-chest was under size in the rough and could not stand cleaning up, and the valves were too small in all directions.

These are the only locomotive castings I have ever bought and I am bitterly disappointed with them.

Incidentally, the cylinder block for the *Thunderbolt*, which the advertiser claims has ports cast in to "save time," was such a bad shape and had such small allowances, that after machining the ports were just irregular dents.

I had a set of ME traction engine castings from Bonds o' Euston Road which were absolutely perfect.

Upminster, Essex. J. L. CLARK.

SIR,—There have been some complaints in your correspondence columns recently of poor service from advertisers and since no names were mentioned the picture is confused and unsatisfactory for all concerned. I should, therefore, like to present another aspect which is more pleasing.

In connection with the supply of castings and materials I have received excellent service from Mr W. H. Hazelgrove and Messrs A. J. Reeves and Co.

The Acorn Machine Tool Co. supplied me, on sale or return, with a lathe centre by return of post in response to a telephone request.

Messrs Buck and Ryan supplied me with a new motorised drilling machine in part exchange for a secondhand one, and some months later when, owing to obtaining increased space for my workshop, I asked them if they would change the bench stand and column for a floor pedestal, they agree to do so at net catalogue difference in price.

I think it is only fair that good treatment should be recorded as well as bad. Usual disclaimer.

Harrow Weald, Middx. W. H. RIDER.

OIL FIRING STEAMBOATS

SIR,—I read the article on the oil firing of model boats [May 2] with considerable interest, particularly with regard to the description and properties of paraffin and petrol.

In this connection I would like to make reference to my experience with commercial petrol as fuel for burners of the vaporising type by way of petrol blowlamps, the action of which is identical with the heat units proposed in the article.

About 1943 I had considerable trouble with these lamps which were fitted with self-cleaning needle pricker valves. I was in a service department then and we had some thousands or more, in use all over the country.

POSTBAG . . .

The first reaction was to suppose that the men had used "dirty" petrol from a container having previously held varnish or thick oil.

Investigation by the chemists revealed that it was due to the cumulative effect of the dope compounds used in commercial petrol, consisting (variably) of "ethyl fluid," having as its components, the following substances: tetra ethyl lead, 54 per cent., ethylene dibromide 36 per cent, hexachloronaphthaline 9 per cent, dye (red or otherwise) 0.1 per cent.

So it was decided to supply the users with petroleum spirit without any of these additives and known on issue as non-leaded spirit.

Further to this, the corrosive effect of the compounds, especially the halogen compound, was very marked on the brass of the blowlamp bodies and I have at present a series of test sample brass wires immersed in ordinary petrol and all have a heavy green growth of corrosion on them.

I would like to know where non-leaded petroleum spirit can be had. I have, to a large extent, used benzene (not benzine) which I get from chemical dealers.

Paraffin, as used domestically, (pink is by Alladin; blue by Esso; and green by Regent) is pure middle-grade petroleum and free from all dopes, (the colour is a distinguishing dye).

Benzine (or Benzolene), at one time specified by the Sievert lamp people, is a pure, non-doped, natural petroleum of about the same B.pt as the average commercial petrol, which is mostly of "cracked" composition and not natural distillate.

Birmingham. W. WARE.

SNOWDON RAILWAY

SIR,—The first-hand information supplied by B. A. Watt and C. E. Carter in reference to the livery of the Snowdon Mountain Railway is much appreciated, and it is always a pleasure to see photographs of any of the engines and/or coaches.

Since writing, I have discovered in *Britain's Railway Liveries*, by E. F. Carter, on page 32, the following: "Snowdon Mountain Railway, 1940. Locos were black. Coaches red or grey." Also in this book (page 242) is a reference to the NGNW and a list of liveries from 1907-30.

With particular reference to B. A. Watt's query regarding *Moel Tryfan* of this line, I learn from Cyril L. Fry, of Churchtown, Co. Dublin, that there is a scale diagram and photograph of the similar engine *Snowdon Ranger* as built, and a photograph of *Moel Tryfan*, in J. Boyd's book *Narrow Gauge Rails to Portmadoc*. There is also a reference in Kinder's *Light Railway Handbook*.

Greystones, Co. Wicklow. M. K. HUGGARD.

EARLY CHARABANC

SIR,—With reference to the picture of the old motor coach [Postbag, May 16], the chassis is apparently a Berna, of Swiss make, (very common 1907-1914). The body is of the type much used for charabanc work prior to the 1914 war.

The local Southdown and Vanguard companies of this period had several of this type, built on Milnes-Daimler and Tilling-Stevens petrol-electric chassis. All have been photographed and listed by the Omnibus Society.

The three men are probably, driver, conductor, and guide.

Brighton, 7. G. GOLDRING.

RETURN-BENDS

SIR,—I was very interested in H. E. White's design for a superheater return-bend [May 23], but in my opinion it has two serious defects.

First, it is made of material no thicker than the superheater tubes, and secondly it does not appear to provide an ample passageway for the steam to reverse its direction on the way to the cylinders.

Four years ago I designed and fitted to my Peckett superheaters similar return-bends, and my method of making them was as follows.

Cut off a piece of $\frac{1}{2}$ in. o.d. by 16-gauge copper tube, face the ends to a length of $\frac{3}{4}$ in. and drill up one end for a distance of $\frac{1}{4}$ in. with a 27/64 in. drill. Remove from chuck and anneal.

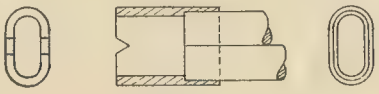


FIG. 1

FIG. 2

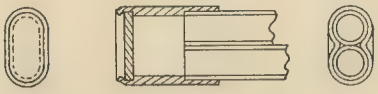


FIG. 3

Details of the return-bend designed by S. J. Applewhite

Squash the piece of tube oval in the vice until two short pieces of $\frac{1}{4}$ in. round will enter the drilled end side by side, and file a notch about $\frac{1}{8}$ in. deep in the other end. The tube will now be as shown in Fig. 1.

Make a little punch from a piece of $\frac{3}{8}$ in. $\times$ $\frac{1}{16}$ in. steel, radius the business end and, with the two pieces of $\frac{1}{4}$ in. round in position, form the drilled end of the tube only into a figure of eight shape. Squash the other end of the tube flat for a distance of about $\frac{1}{4}$ in. and then squeeze it the other way until the V-notch closes up.

The tubes will now be as shown in Fig. 2 and is ready for brazing to the superheater pipes. The squashed end should, of course, be brazed at the same time.

Since making the first set of return-bends I have altered the design to that shown in section in Fig. 3. In this case both ends of the tube are drilled, one end to a depth of $\frac{1}{4}$ in. for the superheater tubes and the other end to a depth of $\frac{1}{8}$ in., eventually to receive a shaped piece of 16-gauge copper to blank off the end of the return-bend.

When brazing to the superheater tubes the recess at the blanked end should be completely filled with brazing metal.

It will be seen that this design provides a return bend of minimum external dimensions and at the same time allows for an ample passageway for the steam with a good thickness of metal where it is most needed.

The superheater tubes can also be close together and it is quite easy to get a flue brush down either side when the superheaters are fitted in the flues.

In my experience this type of return-bend will not let you down. The superheater pipes will fail first due, I think, to a combination of corrosion and abrasion.

Burton-on-Trent. S. J. APPLEWHITE.

CURVE LOCATION

SIR,—Lest some neophyte "estate railway" engineer be confused by Mr Slater's article on curve location [May 2], it should be pointed out that there must be a gradual transition in curvature from the straight tangent to the circular curve. This is called an "easement" and may be computed by several methods. In effect it is a progressive increase of the radius of the circular curve to infinity at the point of curvature. The tangent is *not* actually tangent to the circular curve.

Chestertown, Md. W. LEE GRAVES.

CLUB NEWS

EDITED BY THE CLUBMAN

WHILE every model engineer can be trusted to take extreme care in everything that he makes and operates—model engineering is, after all, impossible without a high degree of thoroughness and exactitude—the importance of rigorous safety measures in all that relates to live steam, highly inflammable fuels and powerful electric currents can hardly be over-emphasised.

The example set by **Harrow and Wembley SME** is therefore to be praised. Harrow and Wembley opened a busy year in live steam by consciously placing the accent on safety. This must be accounted especially wise having regard to the trend in the society towards bigger and better locomotives—such as Bob Jeffries' 5 in. Class 7, the chassis of which he brought along to the locomotive section meeting at which safety was discussed.

Section-leader Fred Cottam gave some practical demonstrations of the very successful pop-type safety valves which he had himself developed and also of a combined vacuum and steam brake with which he was experimenting.

Pressure in the boiler is, of course, not the only possible source of danger. No one should run a locomotive, least of all on a passenger track where the passengers are likely to be small children, unless he can be certain beyond all doubt that he is capable of slowing or stopping it at instant need.

The society is fortunate in having a member so skilful and inventive as Mr Cottam. His brake arrangement provides for controlled simultaneous working of both the train and engine brakes, with a safety device to apply the engine brake in the event of trouble.

Fred also showed an experimental vacuum gauge ¾ in. in diameter, while John Richardson explained the excellent vacuum system fitted to his *Petrolea* and a novel gauge of his own design.

To conclude the meeting, Alan Tyler projected pictures of the old and quaint locomotives which he seems to be able to unearth all over England at a time when they are, alas, rapidly passing into the breakers' hands.

It gives me further pleasure to add that several other members of this active, thoughtful and progressive society have safety schemes similar to Mr Cottam's either in practice or under consideration.

Road to steaming bays

Harrow and Wembley's track, which is 700 ft long and has bridges and gradients, allows continuous running for 2½ in., 3½ in. and 5 in. locomotives. Access to the site has been improved by the cutting of a road convenient for the unloading of cars at the steaming bays.

At any of the track days on the third Sunday in the month visitors, with or without engines, can be sure of a warm greeting and also—so I am told by F. Tucker, of 501 Oldfield Lane, Middlesex, who issues all the information about the society—of a warm cup !

M.E. DIARY

June 21.—Rochdale S.M.E.E., Lea Hall.

June 22.—Railway Enthusiasts' Club camping holdiay at Middleton-in-Teasdale. Birmingham S.M.E. track at Bakelite Sports Ground, Damson Lane, Solihull.

June 23.—Victoria M.P.B.A. regatta.

June 26.—Bristol S.M.E,E. visit to Oakfield Road Control Room, C.E.A., 7.15 p.m.

PHOTOGRAPHIC COMPETITION

CONDITIONS OF ENTRY

1. The photographs submitted shall be of any form of model engineering and must be taken by the competitor but may be developed commercially. Prints should be unmounted, not more than 10 in. x 8 in. and not less than half-plate (4½ in. x 6½ in.).
2. Competitors may send more than one photograph but each must have a coupon from Model Engineer firmly pasted on the back. Coupons will be published each week until the closing date.
3. The closing date will be July 31. Entries to be sent to: Photographic Competition, Model Engineer, 19-20 Noel Street, London, W.1.
4. A first prize of £10 will be provided, with second prize of £5 and third of £3. In addition, 10s. 6d. will be paid for each other photograph published in Model Engineer.
5. Prints will not be returned and the Editor reserves the right to publish any of them in Model Engineer.
6. Copyright of photographs sent must rest with the competitor.
7. The decision of the Editor shall be final in any question affecting the competition.

ENTRY FORM

(To be pasted on the back of each entry)

Name .....
(Block letters)

Address .....

.....

If member of a club, give its name:.....

.....

I agree to the conditions and certify that I took the picture submitted.

Signed.....

DETAILS OF PHOTOGRAPH

Title .....

Builder of model(s) in picture:

Name .....

Address .....

.....

Further details of model(s).....

.....

.....

Camera..... Exposure.....

Film or plate..... Lighting.....

Stop.....

Any other information.....

.....

.....

Model Engineer

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Set "Matrix" Slip Gauges, 0.050" to 4.0", over 80 slips in fitted case including correction slips. Best offer. Also "Newall" dial guage, 25 thou. range in 1,10,000", as new, £2 10s.—Box No. 8547, MODEL ENGINEER Offices.

10" Bandsaw. 3½" wood turning lathe, etc. Enquiries s.a.e.—T. WHITFIELD, 16, Hazelhurst Avenue, Beckfoot Lane, Bingley, Yorks.

Immediate Delivery from Stock, Myford "ML7" and "Super 7" lathes, Super Adept lathes, bench planers, shapers, electric motors, small tools.—F. W. KUBACH, 12, Sylvan Road, London, S.E.19. LIV 3311—12.

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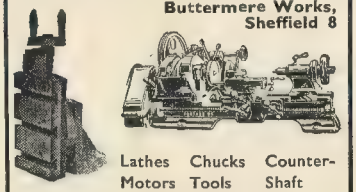

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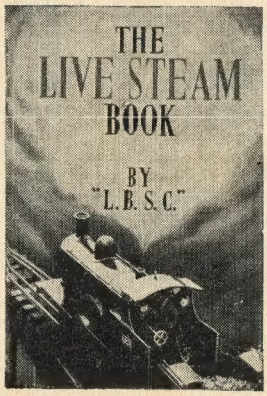

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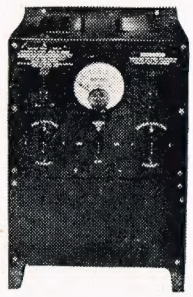

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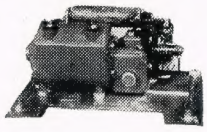

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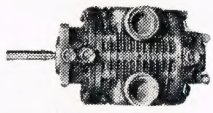

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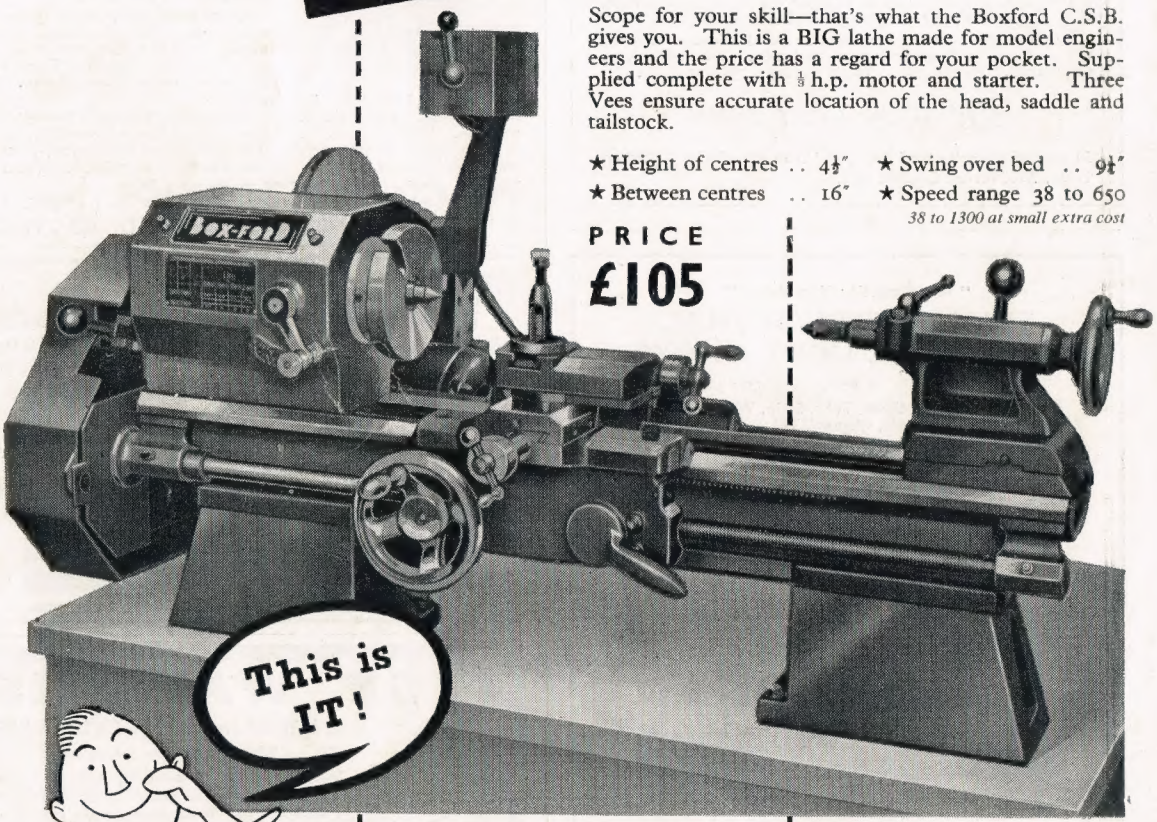
★ Height of centres .. 4½″ ★ Swing over bed .. 9½″
★ Between centres .. 16″ ★ Speed range 38 to 650
38 to 1300 at small extra cost

PRICE
£105



Model C.S.B.

BOX·FORD

4½″ CENTRE LATHE

Send for fully detailed leaflet TODAY!

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